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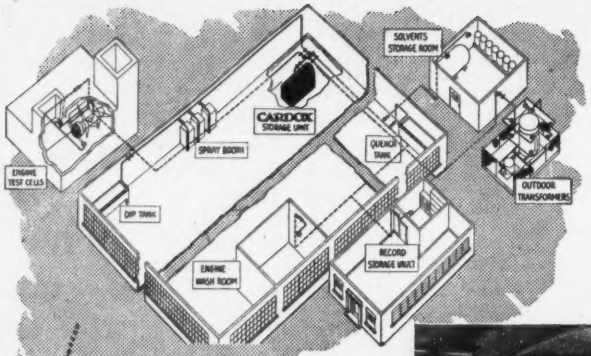

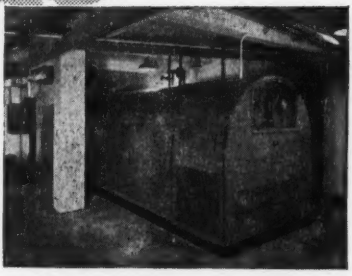

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QUARTERLY

of the

NATIONAL FIRE PROTECTION ASSOCIATION

Vol. 40 April, 1947 No. 4

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Accounts of fires appearing in the Quarterly are copies of or extracts from reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

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Press Association.

Those who mistakenly object to automatic sprinklers through fear of water damage should note that in the absence of sprinklers to extinguish fire in its incipiency, the fire department may have to use a hundred times as much water. This picture shows a fire in a Philadelphia fur store, Jan. 22, 1947, which illustrates several important points in addition to the lack of sprinkler protection: combustible interior construction, unprotected vertical openings, delayed alarm, no automatic fire alarm or watchman service.

The Quarterly

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The Value of Contests. Americans and Canadians are contest-minded. The traditions of free enterprise and free competition of our countries have made them great and the competitive spark is still strong among our peoples. Competitions in the field of fire fighting and fire prevention have always been valuable in promoting efficiency and effort. Competitions in drill evolutions in fire departments and competitions among fire brigade units of industrial plants are always worthwhile. On the large scale, the year-round competition for fire prevention effort on the part of municipalities conducted by the National Fire Waste Council of the United States Chamber of Commerce has been for many years an effective device for enlisting the interest of local communities and local Chambers of Commerce in fire prevention activity. Chamber of Commerce secretaries who have enrolled their communities year after year in this contest will testify to its value in stimulating local interest in fire prevention work. The N.F.P.A. annual contest for excellence in Fire Prevention Week activities in cities, sponsored so ably by Chairman T. Alfred Fleming of the Committee on Fire Prevention and Clean-up Campaign, has increased in scope and enthusiasm over the years and now attracts entries from thousands of American and Canadian cities.

A new and effective twist to the contest idea was created by Jay Stevens of the National Board of Fire Underwriters when at a luncheon in Dallas, Texas, attended by city officials, the press and representative citizens, to hear his observations on fire protection and prevention in that city, Mr. Stevens proposed a contest between Dallas and Houston for reduction in fire losses and excellence in fire prevention activities, and proposed that at the conclusion of the contest the mayor of the losing city hold a dinner for the mayor of the winning city, the winning mayor to eat beefsteak and the losing mayor to eat crow. This suggestion, made perhaps semi-humorously by Mr. Stevens, caught on and was taken up by the press of the two cities. The competitive spirit of these rival communities was aroused and a vast amount of fire prevention activity of constructive value to both cities ensued. Recently Mayor Otis Massey of Houston ate a North Dallas, corn-fed crow, while Mayor Rogers of Dallas was feasting on beefsteak. The contest is now organized on a five-year basis and fire departments, Chambers of Commerce, and the public of Houston and Dallas are gainers.

We suggest that this plan which has operated so effectively deserves a wider usefulness. Why should not New York and Chicago enter into such a competition, and Boston and Baltimore, or Montreal

and Toronto, Los Angeles and San Francisco, Hartford and New Haven, Minneapolis and St. Paul, etc.? Cities that are in the same general class of population or are otherwise natural rivals might well emulate the example set by Houston and Dallas and even the mayors who would have to eat an occasional crow would, we believe, agree that it was all worthwhile.

* * *

Adoption of N.F.P.A. Standards by Reference

There is an increasing tendency on the part of local governments to adopt national standards by reference, rather than incorporating in local ordinances the full details of the comprehensive standards needed for complete control of the hazards of the storage and handling of flammable liquids, gases, and similar technical subjects. This practice has sometimes been questioned as inconsistent with state constitutional requirements or as constituting an improper delegation of legislative power. However, as a practical matter, particularly in the smaller community, there is no feasible alternative to some sort of adoption of national standards by reference. The hazards of gasoline, solvents, combustible gases and the like, are the same in the small community as elsewhere and public safety calls for regulation of all details. It is not practical in the individual community to draft detailed ordinances, particularly where there are already available nationally recognized standards which cover the subject adequately. Furthermore, the small community is frequently not able even to afford the expense of complete publication of the text of detailed requirements which would be necessary under the provisions of law requiring the publication of all ordinances. Recent court decisions have recognized the practical aspects of the situation and the local adoption of recognized national standards on fire safety has been commonly upheld by court decisions. A typical case was the recent decision of the Texas State Supreme Court where the N.F.P.A. standards on liquefied petroleum gas were upheld (QUARTERLY, April 1946, page 321).

An interesting example of adoption of N.F.P.A. standards by reference is found in the recently adopted zoning ordinance of the Borough of Paramus, N. J., from which the following is quoted:

> 5:8-7. **Petroleum Storage.** In the storage and use, whether for sale or as an incident to a permitted use, of any flammable liquids or liquefied petroleum gases, the installation and maintenance of such storage facilities and of allied equipment shall be in strict accordance with the codes and recommendations of the National Fire Protection Association applicable thereto, namely, Chapter I, Sections 2 and 3, chapters II to VI, inclusive, of the Flammable Liquids Ordinance, and the Appendices thereto relating to Tanks in Flooded Regions and Rooms, Cabinets and Outside Houses for the Storage of Flammable Liquids; and the Introduction, Application of Rules, Basic Rules and Divisions I, II, V, and Appendices A and B of the code concerning Liquefied Petroleum Gases; all as set forth in the volume published by the National Fire Protection Association entitled "National Fire Codes Vol. I Flammable Liquids, Gases, Chemicals and Explosives" 1945.
>
> Said printed codes are annexed to this ordinance and the portions thereof hereinabove described are marked and are hereby incorporated as a part of this ordinance. Three copies of said codes, similarly marked, have been placed on file in the office of the Borough Clerk upon the introduction of this ordinance and will remain on file there until final action is taken on this ordinance, for the use and examination of the public.

Meeting of Board of Directors.

New York, January 24, 1947.

Present.

George W. Elliott, chairman
Curtis W. Pierce, president
Hovey T. Freeman, secretary-treasurer
David J. Price, past president
Richard E. Vernor, past president

Malcolm S. Blake	Frank Epps
A. L. Brown	Russell Grinnell
Hylton R. Brown	A. J. Mullaney
Loren S. Bush	John A. Neale
Allen L. Cobb	H. E. Newell
Jack C. Curtis	A. H. S. Stead

Percy Bugbee, general manager, Robert S. Moulton, technical secretary, Horatio Bond, chief engineer, Charles S. Morgan, engineer, Warren J. Baker (present during part of meeting as representative of Committee on General Storage).

Business Transacted.

1. The program of the 51st annual meeting was discussed and the dates and place confirmed (Chicago, May 26-29, 1947). It was voted that at forum sessions of the annual meeting no motions should be entertained.

2. Treasurer Freeman reported on the finances of the Association. This report was accepted and approved. The Board discussed without specific action various proposals for increasing the revenues of the Association.

3. The following Executive Office reports by members of the staff were presented, discussed and accepted: Membership, Publications, Advertising, the National Conference on Hotel Fire Safety called by the N.F.P.A. on January 16, progress in the development of a model hotel law, N.F.P.A. activities in connection with President Truman's proposed Conference on Fire Safety, the status of the Fire Marshals' Section, and progress in training for firemen.

4. It was voted to refer to Chairman Elliott with power the appointment of a new Chairman and reorganization of the Committee on Long Range Planning.

5. An interim report of the special Board Committee on Branch Circuit Protection, Hylton R. Brown, Chairman, was received and accepted in principle. It was voted to circulate this report to members of the Board for study and further consideration at the next meeting of the Board, with the purpose of submitting a Board report on this subject to the next annual meeting of the Association for action. The special committee was continued.

6. It was voted to confirm the following letter ballot actions taken by the Board since the last meeting.

Authorization to submit the National Electrical Code to the American Standards Association for approval as an American Standard with the incorporation of a note following Par. 2452 suspending the mandatory provisions of this paragraph pending the completion of investigation of branch circuit protection and further action; and the adoption of a revised edition of the standards on Liquefied Petroleum Gases as submitted by the Committee on Gases.

7. On recommendation of the Committee on Finishing Processes, it was voted to adopt as an additional section of the Standards on Dip Tanks, requirements on Electrostatic Apparatus (detearing). This text was published in the October 1946 NEWS LETTER and will be incorporated in subsequently published editions of the standards.

8. The report of the Committee on Technical Committee Procedure was

adopted as presented by Chairman Pierce, and on recommendation of this committee it was voted to change the name of the Committee on Museums, Art Objects and Historic Buildings to "Libraries, Museums and Historic Buildings" and to amend the scope statement by insertion of the word "libraries."

9. The request of the U. S. Department of Commerce for N.F.P.A. approval of their Proposed Commercial Standard on the Flammability of Textiles, TS4128, which had been considered at the July 1946 meeting of the Board and referred to the Committee on Technical Committee Procedure for review and recommendation, was on recommendation of the Committee on Technical Committee Procedure adopted with the exception of provisions therein referring to labeling "to assure purchasers that they are obtaining fabrics or products made therefrom which will not prove to be a fire hazard and are thereby not a menace to life." The N.F.P.A. Executive Office was instructed to advise the Department of Commerce of this action and to explain that the exclusion of the provisions on labeling from N.F.P.A. approval of the balance of the standard is due to the view of the Board that no labeling by manufacturers without some sort of follow-up and supervision can assure safety to life in all cases, and furthermore that it is contrary to N.F.P.A. policy to approve provisions of a standard such as this which might be construed as an implied guarantee of safety to the public based upon unsupervised representations by manufacturers.

10. A proposed revised wording for Par. 416 of the Tentative Standards on Fur Vaults on which action had been deferred by the Board at the last meeting was discussed and the following revised text adopted upon assurances from Mr. Warren J. Baker, authorized representative of the Committee on General Storage, that the revised wording will be acceptable to the committee.

416. All vaults shall be protected as outlined in both of the following items, as approved by the inspection department having jurisdiction.

(a) An approved system of automatic sprinklers or an approved automatic inert gas fire extinguishing system.

(b) An approved smoke detector system or an approved smoke detector system and approved automatic fire alarm system.

NOTE: It is understood that where the equipment furnished under (a) includes the features listed under (b) it shall be considered that the requirements under (b) have been complied with.

11. On recommendation of the Committee on Technical Committee Procedure, it was voted to confirm all appointments made by this committee under the authority of Board action at the last meeting and incorporated in the committee lists appearing in the 1946-47 Year Book. Additional committee appointments were also confirmed.

Can Aircraft Crash Fires be Prevented?

By George H. Tryon, III,
Secretary, N.F.P.A. Committee on Aviation and Airport Fire Protection.

There is no justification for viewing fire as the inevitable result of aircraft crashes. Those engaged in fire prevention work know that cures do exist for fire causes. Whether these cures are simple or complex, fires can be prevented.

In aircraft crash fires, prevention depends upon the determination of the aeronautical engineer to provide the necessary safeguards. This is comparable with the architect's responsibility to design fire-safe structures.

The inherent nature of aircraft has given rise to the general misconception that the impact fire problem defies solution. This reaction should not be dismissed without pausing to inquire as to its validity.

Obviously, placing tremendous quantities of gasoline in frail containers directly behind high horsepower reciprocating engines, adding the lubricating oil and hydraulic fluids, the electrical, exhaust and heating systems, the cargo and passenger compartments, the auxiliary power units, galleys and batteries, truly produces a fire-wise monstrosity. It is to the everlasting credit of the aeronautical engineer that he has done all this, added the human factor, and produced something that flies, is safe to fly, and has a fire record in flight that is remarkable when viewed from the constituents that make the hazard.

It is at the time of impact, at the time of collision with an irresistible force, that all the skillful engineering of the aeronautical engineer goes "by the board." Then, all these potential hazards are placed in juxtaposition, and, in such proximity, become essentially uncontrollable, or, at least, unpredictable, and highly explosive.

The Cures.

Breaking down the problem into its component parts is the most apparent way of seeking a solution. Obviously, the gasoline involved is the number one hazard. Aviation "high-flash" fuel is the only answer. To be sure, there are practical problems in its utilization and there is no desire to minimize these problems. Without discussing such factors here,* it is safe to say and logical to advance that the employment of "high-flash" fuels is obligatory for fire safety in aviation. The recent tragic catastrophes provide sufficient evidence to require this added degree of safety.

A non-flammable hydraulic fluid is the second essential. Present-day hydraulic fluids which ignite readily from the heat of an engine or from the spark of a broken electrical circuit constitute an ignition potential as well as a combustible element. Research to develop a non-flammable substitute is progressing favorably under the guidance of the Civil Aeronautics Administration.

The burning characteristics of aircraft lubricants have nothing to do with their functional use. It is reasonable to expect that future research will also develop a non-flammable substitute for such hydrocarbons. Iodine inhibitors to retard combustion of lubricants also possess considerable promise.

*See Bulletin No. 7, N.F.P.A. Committee on Aviation and Airport Fire Protection.

Press Association.

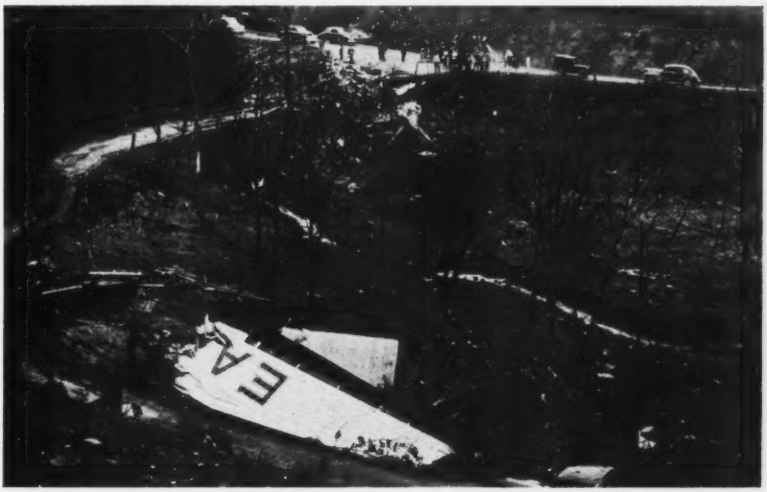
How an integral type fuel tank contributes to the fire hazard is vividly illustrated in this photograph. The DC-4 aircraft involved suffered fire in flight on September 12, 1946, following exhaust valve failure which split No. 2 cylinder head in the outboard engine. The engine fell free as the plane touched the runway at the Washington National Airport. Fuel from the wing tank fed the flames and wind drove the fire toward the fuselage. Lack of co-ordinated fire fighting resulted in a total loss.

Press Association.

A commercial airliner struck a marker house landing at the Chicago Municipal Airport on January 6, 1947. While forty-one occupants escaped without injury, the aircraft was a total loss because of fire damage. The shock imposed on the landing gear sheared a portion of the main wing spar, causing a gasoline leak and subsequent ignition. Design improvements could eliminate such ignition potentials.

The Eastern Air Lines flight to Miami from Detroit on January 12, 1947, ended tragically near Galax, Va. Eighteen occupants were killed as flames devoured the fuselage, while neighbors rescued one passenger from the burning wreckage. Freak radio conditions, which led the pilot off his course, are indicated in preliminary reports as the cause of the crash. The evidence indicates that the impact was without warning and that explosion and fire followed the loss of the wing, pictured in the foreground.

Journal and Sentinel, Winston-Salem, N. C.



Press Association.

Even where fire equipment is available, crash fires are often of such magnitude that control cannot be established in the time necessary to rescue all occupants. On Sept. 24, 1946, this B-25 crashed at Washington National Airport and burst into flames immediately, causing the death of four occupants. Fire fighters were able to drag two men from the burning wreckage and saved their lives.

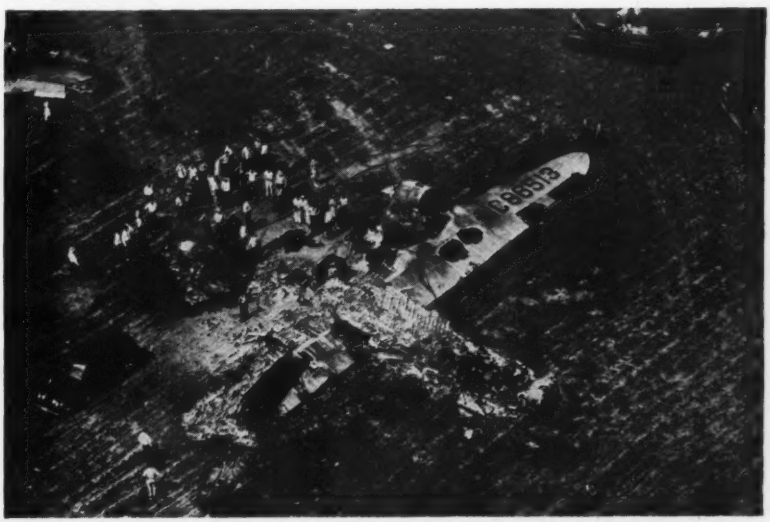
This Navy hospital plane, executing a radar-controlled landing at the Oakland, Calif., Municipal Airport on January 20, 1947, undershot the field and struck an embankment. The fuel tanks were split open, fuel lines ruptured, and electrical circuits exposed. The resultant fire could not be extinguished, despite adequacy of equipment, because of terrain difficulties and the constant reignition of vapors by burning magnesium alloy parts. One person was killed, three suffered major burns, and eighteen, thrown clear of the fire area, suffered injuries.

Press Association.

Fire in flight, caused by failure of the generator lead-through stud installation in the fuselage skin of the forward baggage compartment, caused this accident. Ignition of hydraulic fluid was a predominating factor in the extent and rapid spread of fire which prevented control at incipiency. Air flow in the interior of the aircraft spread the flames into the cockpit when one of the crew went to investigate smoke through the access opening. The accident occurred on July 11, 1946, at Reading, Pa.

Fires at time of ground impact are not limited to large aircraft. Pictured below is the burning wreckage of a Model D 18S, single engine, two-place Beechcraft which crashed at Wichita, Kansas, on April 7, 1946. An estimated 286 gallons of gasoline were involved in the fire. The two persons killed, in this case, were thrown clear of the wreckage and landed in a gasoline spill which ignited instantaneously. One passenger miraculously escaped.

Press Association.



Flammable materials used in aircraft cabins and compartments in the form of soundproofing materials and upholstery are, of course, unnecessary combustible elements. Positive attacks on this hazard are being taken today with effective results. Where non-combustible materials are not employed, flame-retardant treatments are given to fabrics with effective results.

Even with "high-flash" fuels, there also exists the need for crash-proof fuel tanks, fire-resistant aircraft plumbing, and automatic fire protection. As the term "high-flash" implies, the fuel is merely less hazardous than conventional aviation gasolines. Once ignited, it will burn and burn readily and, because of properties peculiar to its employment in aircraft, there remains an explosion potential under certain adverse conditions.

The use of integral fuel tanks (where the wing itself constitutes the tank) should clearly be eliminated. Experience has shown that sealing such tanks to prevent leakage cannot be guaranteed because of stress and strain accompanying impact forces and high vibrations. Flexible steel, flammable liquid plumbing must replace present types of tubing, and such materials are available.

Fire extinguishing equipment provided for aircraft must incorporate impact actuators which flood potential danger zones with an inert or fire blanketing gas, stop the power plant and operate the battery cut-off switch. This provision, while sounding like "protection," actually is "prevention."

Engineered air-flow control inside aircraft (to prevent drafts) and compartmentation of both passenger and cargo areas are necessary for safe ventilation and segregation of combustible materials. Effective fire bulkheads in strategic locations would confine a fire to its place of origin.

Moving the landing gear inboard and strengthening the fuselage to absorb the shock of landing would eliminate applying stress to the fuel tank supporting structure. This revision of the commonplace has been accomplished in the Burnelli "lifting wing" design. Another feature of this latter type aircraft is the shifting of fuel tanks so that they are not in direct line with the power plants and their exhaust outlets.

Conclusions.

These are a few of the fire prevention measures that can be taken by aeronautical engineers to eliminate fires at the time of ground impact. They are some of the points which the N.F.P.A. Committee on Aviation and Airport Fire Protection* is investigating in an effort to increase fire safety for air transportation. The program is undertaken in the realization that our future is in the air and that it must be safeguarded.

**Aeronautical Organizations Participating*—Aircraft Industries Association, Aircraft Owners and Pilots Association, Air Ministry Fire Services (Great Britain), Air Transport Association, American Association of Airport Executives, Army Air Forces, Bureau of Aeronautics —Navy Department, Civil Aeronautics Administration, Civil Aeronautics Board, Institute of the Aeronautical Sciences, National Aeronautic Association, National Association of State Aviation Officials, Port of New York Authority, Royal Canadian Air Force.

Advisory Organizations — Daniel Guggenheim Aeronautical Laboratory, International Aviation Organization, National Advisory Committee for Aeronautics.

Recent Fires.

The following summaries of large loss fires reported to the N.F.P.A. during the past quarter represent only a small portion of the important fires that have occurred in the first three months of 1947. These reports, selected as typical examples, present a devastating picture of day-to-day fire experience. They show how little heed has been paid to the lessons of previous disasters, and how vast is the field for constructive activity in the field of fire safety.

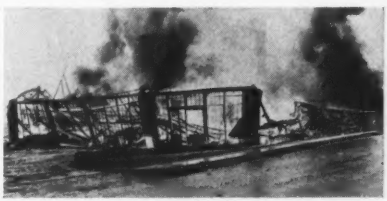
Jan. 2, 1947, Albany, N. Y. Liquor Warehouse and Truck Terminal and Warehouse.

Sounding of a burglar alarm at 2:01 A.M. brought a protective serviceman and a police prowl car to the river-front warehouse owned by the city of Albany and leased in largest part to the Colony Liquor Distributing Co. and the John Vogel Trucking Co. At 2:08 A.M. a telephone alarm was received by the fire department. The policeman who responded to the burglar alarm pulled a local street box at 2:09. A second alarm was sent in by the chief officer responding at 2:17, a third at 2:38, and a call for additional hose was placed at 3:12. Thus, fire-fighting forces were mobilized to fight a fire which ultimately caused almost total loss to the building and contents.

Structural conditions also militated against limiting the extent of fire damage. This building was 800 ft. long, one story in height (except for two-story office sections at either end), of brick construction with a tile gable roof. Loading platforms were provided along the shore side with overhead metal loading doors which were chain locked from the inside. The building lacked automatic sprinkler protection and was one fire area. The only partition was a wire mesh with cardboard covering separating the liquor warehouse section from the trucking company storage. A false ceiling covered the entire one-story section to aid in heating. The burglar alarm had been installed in the liquor portion.

The nature of the storage aggravated the fire and made control, following the delayed alarm, almost impossible. As equipment reached the scene in a sleet storm, water was observed running off the roof as if it were raining. This indicated that the fire had already involved the entire interior and was inside the hanging ceiling throughout its 800-ft. length. Entrance to the structure was first gained by cutting through the metal loading platform doors. (The waterfront side was not accessible, as the building was built to the edge of the dock and the basin was frozen over but the ice was not heavy enough to support men.) Soon after applying the first hose streams a violent explosion occurred which blew fire fighters to the street, one man being hurled 40 ft. A sheet of flame followed the explosion through the opened door and sent flames roaring through the entire structure. A second explosion followed and blew some of the tile off the roof. Obviously the liquor in storage gave the fire tremendous impetus. That it had been burning for some time before even the burglar alarm sounded was indicated by the fact that the metal doors of the liquor company were described as being "cherry red" when the fire department arrived. Final extinguishment could only be secured by the use of multiple hose streams and large volumes of water.

The dollar loss involved cannot be accurately estimated at this time because some dozen different insurers are affected. Insurance coverage on the building was known to be $50,000 (probably underinsured) and the liquor was covered under a $350,000 policy. Liquor salvage is estimated at $150,000. Total loss will probably be between $250,000 and $500,000.



Acme.

Flxible Co., Loudonville, Ohio, Jan. 2, 1947. Loss: $800,000.

Jan. 2, 1947, Loudonville, Ohio. Funeral Car and Bus Manufacturing.

Early in the afternoon, while the plant of the Flxible Co. was in full operation, fire originated in one of 3 sections of the 50,000 sq. ft. building near a parts cleaning operation involving the use of highly volatile paint thinner. Flames swept through this wing (a 1-equals-2-story, unsprinklered building of steel frame construction) into a 2-story, reinforced concrete,

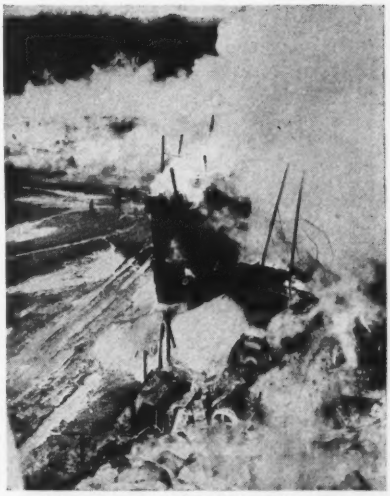
Acme.

Weehawken, N. J., Jan. 8, 1947. The latest in a long series of costly examples of the results of not observing the recommendations of the N.F.P.A. Committee on Piers and Wharves. This pier had an unbroken area of over 5 acres of creosoted piling and timber in the substructure, lacking automatic sprinklers and inaccessible for fire fighting. Loss estimated up to $6,000,000.

fire-resistant section through unprotected openings. The spread was so rapid that employees barely had time to escape. Flames destroyed 10 completed funeral cars, 40 in various stages of assembly, parts for 100 others, and a large stock of replacement parts for both funeral cars and buses. Even more disastrous was the destruction of blueprints, patterns, and specifications for both present and previous models. The local volunteer department responded promptly to the telephone alarm with all its equipment (one pumper, one hose and chemical truck), and departments from 5 nearby communities were also called immediately. Despite ample water supplies and proper functioning of all equipment, the entire wing originally involved was destroyed and a large part of the contents of the fire-resistive section was destroyed or damaged. Although company and state officials investigated thoroughly, it was impossible to fix the cause definitely. Employees stated that the start of the fire was so sudden that they could not recollect any factors which might have contributed to the ignition. The flames were first detected at the floor level and presented the appearance of a flammable vapor fire. The origin of the vapor remains a mystery, as it is alleged that only a small quantity of thinner was in the building at the time. Estimated loss: building, $140,000; contents, $560,000; use and occupancy, $100,000; total, $800,000.

Jan. 5, 1947, Tiptonville, Tenn. Soya Mill.

Fire of undetermined origin was discovered by the watchman at 4:10 P.M., just after he had completed his hourly round in the mill building of the West Tennessee Soya Mill, Inc. The plant is one of the largest in the state, handling 20,000 tons of soy beans a year and doing an annual business of more than $2,000,000. At the time of discovery, flames had spread through the upper portion of the one-story, frame and skeleton ironclad building. The mill was rapidly consumed and within 15 minutes fire had also involved a one-story, frame, cottonseed and soya warehouse 61 ft. from the mill. Firemen from Tiptonville and Ridgely fought the blaze with 7 hose streams, but it was soon obvious that both the mill and warehouse were lost and part of the fire-fighting equipment was diverted to protect exposed seed tanks and the cottonseed mill. A number of small lint fires occurring on the roof of the cottonseed mill were extinguished by plant personnel. The sprinkler system of this mill building (the only one in the group with such protection) was not involved. Efforts of fire fighters were hampered by the rapid spread of fire through the large, high, frame structures, sub-freezing weather, and fatigue as a result of fighting a large sawmill fire a few hours previous. The loss was estimated at $720,000 with 74 per cent on contents.



Soy bean mill, Tiptonville, Tenn., Jan. 5, 1947. Loss: $720,000.

Jan. 5, 1947, St. Bernard, Ohio. Animal Feed Plant.

Twenty-five thousand bushels of grain, soy bean meal, peanut oil meal, bran, and dried milk were destroyed by a fire which leveled the NuWay Feed Co. amid dust explosions. Discovered about 10 P.M., the 28,000-sq.-ft., 3-story, galvanized iron structure was a mass of flames in a matter of minutes and seriously threatened nearby fuel storage tanks of the Este Oils Co. Failure of owners to prearrange for fire services from nearby Cincinnati delayed response of their equipment until after the owner of the exposed property guaranteed payment. Loss estimate: $307,000.

Jan. 8, 1947, Weehawken, N. J. Railroad Terminal Pier.

A costly example of what can happen to many of the pier properties in the ports of this country is furnished by this fire, which destroyed a merchandise pier in the New York Central Railroad and damaged an adjacent pier. The destroyed pier, built in 1883, was 1200 ft. long by 200 ft. wide, of wood construction. A 2-story frame superstructure completely covered 825 ft. of the outshore end. Two railroad tracks ran the full length in the center of the pier. A one-story frame shed covered loading platforms for a distance of 375 ft. on the inshore portion.

There was no automatic sprinkler protection or fire division walls in the pier sheds or in the substructure.

Originating about 5:45 A.M., the fire totally involved the first pier within 30 minutes. As in other pier fires, the lack of fire stops prevented all hopes of localizing the flames and a 30 mph. wind fanned the fire and ignited the substructure of the second pier across a 250-ft.-wide slip. Employees were engaged in freight handling and loading at the time the fire originated. There were 46 railroad cars on the pier and 15 barges in the fire area. All the barges and 30 of the cars were safely withdrawn by employees. Despite this saving, substantial quantities of incoming and outgoing merchandise were destroyed, including electrical appliances, lumber, automobile parts, foodstuffs, mosaic tiles, general merchandise and chemicals.

The alarm was first given over the New York Central local alarm system at 5:47 A.M. Hose lines were laid by the employees, and, upon the arrival of the railroad fire chief at 6:03 A.M., an alarm was telephoned to the Weehawken Fire Department. It will be noted that this alarm was 16 minutes after initial detection. Hose lines were used from hydrants of the private water system under good pressure from pumps of total capacity of 2250 gpm. Intake hydrants were provided from which pumpers could take suction directly from the river. A 500 gpm pumping unit taking suction from the river was operated by employees. The fire departments of Weehawken, West New York, North Bergen and Guttenberg responded to the public alarm. Some of the city apparatus proceeded to the scene of the fire while other units were strategically placed in the terminal area in case of a change in wind direction. The fire brigades of employees continued fighting the fire under the direction of municipal fire fighters. In all, 7 pumpers, 2 ladder trucks, 3 fireboats, and 26 tugs equipped with fire-fighting facilities were engaged in the extinguishment operations. While the pier originally involved was totally destroyed, notable success was achieved in extinguishing the fire in the substructure of the adjacent pier despite the fact that the latter fire gained considerable headway before fire-fighing forces could be mobilized to the defense. Bad smoke conditions existed throughout the fire and the creosoted substructure contributed to the intensity of the blaze.

The fire was originally reported to have been caused by the spilling of a drum of calcium carbide and the subsequent ignition of acetylene gas generated by its contact with water. The ignition source was undetermined. Further investigation has not substantiated this cause and the fire is now listed as of unknown origin. The detailed work connected with filing of claims for merchandise destroyed and establishing the sound value of the pier has delayed release of authoritative information on the amount of the damage. Estimates now run between $3,000,00 and $6,000,000.

Acme.

Syracuse University gymnasium, Jan. 12, 1947. Loss: $400,000.

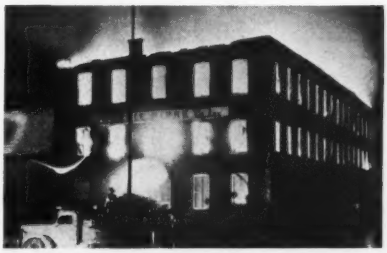
Jan. 10, 1947, Goose Bay, Labrador. Hangar.

An aircraft maintenance hangar on the American side at the Goose Bay airport was totally destroyed by a fire which was first discovered by passing civilians at 4:30 A.M. As fire equipment reached the scene, flames were observed coming through the roof and a great amount of heavy, black smoke was pouring from the 45,000-sq.-ft., all-frame structure. Pumpers went into immediate action, using high pressure water streams on the inferno, but an explosion soon after the first line was laid made all attempts to save the structure hopeless. Flying embers endangered nearby buildings, but base personnel successfully extinguished all incipient fires in exposed structures. Two C-54 aircraft stored within the hangar were lost, as well as all the maintenance and overhaul equipment installed in the building. A temperature of –14° F. complicated fire-fighting activity. Crash trucks used to patrol the base during the fire were forced to return to quarters as their water piping and fittings froze. The cause of the fire could not be determined, but previous inspections had condemned open flame heaters used in the hangar. These had not been removed at the time of the fire. Loss estimates given are: building, $650,000; aircraft, $356,000; other contents, $606,949; total, $1,612,949.

Jan. 12, 1947, Syracuse, N. Y. College Gymnasium.

The substantially constructed Archbold Gymnasium of Syracuse University was gutted by a fire which originated either in the athletic

equipment storage room on the first floor or among finishing materials in back of the bowling alleys. Flames gained tremendous headway in the building, heavily involving the third (top) floor before being detected at 6:03 A.M. by the campus watchman, who saw smoke issuing from the windows. Built in 1907, the structure was essentially steel frame in brick and concrete pilasters, brick-faced, with floors of reinforced concrete and tile on unprotected steel. The roof was concrete on unprotected steel. A wood gallery and running track was suspended above the gymnasium on the top floor. All stairwells were open. No automatic sprinkler or detection equipment was installed, and the watchman's rounds were neither supervised nor regular. The flames consumed nearly everything burnable on the first floor and the heated gases rose through the rear open stairway, largely bypassed the second story, and ignited the wood track and balcony on the top or gym floor. The heavy roof collapsed and the steel trusses buckled and brought down the upper side walls. The fire damage on the second floor was small, despite extensive wood partitions enclosing handball courts. Even the wood handrails on the rear stairway were not completely consumed, and glass-enclosed trophy cases near a front open stairway were intact. What fire did not damage, however, water did, as fire-fighting activity was confined to pouring tons of water into the building from the exterior and saving seriously exposed structures, including a library. Fifteen hose streams were used in fire-fighting operations. While replacement cost will be several times the insurance coverage provided, the loss is figured at $400,000.



Acme.

Colonie Fibre Co., Colonie, N. Y., Jan. 13, '47.

Jan. 13, 1947, Colonie, N. Y. Shoddy Mills.

Fire, caused either by friction of stock accumulating at the end of a shaft on a garnett cylinder or by foreign material in stock in process, swept through the old, 3-story, brick joisted, main shoddy mill of the Colonie Fibre Co. Premature closing of the sprinkler control valve allowed flames, once under sprinkler control, to rekindle and spread disastrously, feeding on the combustible shoddy and a plywood sheathed ceiling. The plant was operating 24 hours daily and there was a night shift on duty on the third floor when the fire occurred at 8:55 P.M. By about 9:05, flames were so nearly extinguished, following sprinkler operation and the use of small hose lines by employees, that the foreman shut off the water by closing the valve on the first floor. When he returned to the third floor, however, fire had again broken out and had spread over this section, fusing most of the sprinkler heads here and a considerable number on the second floor. This resulted in a tremendous draft on the water supply when the valve was reopened between 9:10 and 9:20. The 15,000-gal. gravity tank undoubtedly was exhausted within a few minutes. The entire sprinkler system was 57 years old, having been installed in 1890 with no major improvements since that date. No one called the local fire department for a full 30 minutes from the time of detection. When firemen did arrive at the scene, the mill was totally involved and help was requested from 4 nearby departments. Four public hose lines were used from the 12-in. street main and 2 additional streams were obtained by pumping from the nearby river basin. The fire was brought under control 5 hours later. Estimated loss: $331,000.

Press Association.

This church fire, Buffalo, N. Y., Jan. 14, 1947, was due to a gasoline blow torch. Loss: $300,000.

Jan. 14, 1947, Buffalo, N. Y. Church.

Careless use of a gasoline blowtorch by workmen removing paint from a dormer was the cause of a fire which destroyed the entire roof

and altar and did considerable damage to the auditorium of the Church of St. Mary of Sorrows. The ignition of this dormer at 3:18 P.M. followed an earlier fire (11:00 A.M.) from the same type of operation which was controlled by a hand extinguisher. The afternoon blaze went quickly beyond control because the dormer window was open and gusty winds swept the flames into the open cockloft (200 ft. by 65 ft.), which contained no stops or partitions. Bad dust conditions and flammable debris in the attic served as fuel to the fire. The roof was slate covered, but the wood underplanking and framing were quickly ignited. Three ladder pipes were placed in service, as well as powerful turret nozzle streams, by fire-fighters responding to simultaneous box and telephone alarms. Hand lines taken to the 85-ft.-high peaked roof on ladders were not effective. Building and contents loss has been estimated at $300,000.

Peerless Paper Mills, Oaks, Pa., Jan. 15, 1947. Loss: $294,000.

Jan. 15, 1947, Oaks, Pa. Paper Mill.

The Peerless Paper Mills' main plant was a one-story building, 260 ft. by 120 ft., of mixed brick, glass in steel sash, and frame ironclad construction. The roof was part wood and part corrugated metal on wood, supported by bare steel trusses. The entire area, even to the boiler room, was without fire stops. No automatic sprinkler or detection equipment was provided and no private facilities were available for emergency water supplies. This industrial village had a volunteer fire company with only a single pumper. With existing conditions it should have been obvious that any fire which went beyond possible control of hand extinguishers would probably cause a total loss. Such was the result in a fire discovered by employees in the storeroom at 7:45 P.M. While the night crew was unsuccessfully attempting to extinguish the fire with extinguishers, the Oaks Fire Department was called and responded at 7:55. Immediate calls for assistance brought volunteer companies from 4 nearby communities. Booster tank water supplies were quickly exhausted without appreciable effect. Lines were laid 1000 ft. to a nearby quarry, 1200 ft. to one private plant and 1500 ft. to another private industrial water supply. At best, only 650 gpm was ultimately available. The plant was a total loss and one bystander was killed by a falling wall. Estimated loss: $294,000.

Jan. 15, 1947, St. Joseph, Mo. Clothing Store.

The 3-story, unsprinklered, steel and concrete mercantile building housing the Plymouth Clothing Co. was heavily damaged by fire, first reported by a passer-by at 10:50 P.M. Flames extended from the main floor up an open stairway, open elevator shafts, and air conditioning ducts to the third floor. A concrete ceiling on the top floor confined smoke, heat and gases to the interior of the building. Several explosions, caused by this accumulation of heated gases, blew out plate glass display windows. Firemen arriving at the scene laid hose lines through the main and side doors and directed streams from ladders to the second floor. Attempts to gain entrance to the office section (where the fire seems to have originated) were defeated by heavy burglary protection consisting of wired glass windows, iron bars and steel mesh wire. Water supplies were adequate, with ample fire hydrants within 600 ft. and hydrant pressures of 105 lbs. Five engine companies and one ladder company responded. Eleven $2\frac{1}{2}$-in. and six $1\frac{1}{2}$-in. streams were employed. Cause remains undetermined. Loss $575,000.

Jan. 20, 1947, Summit, Ill. Factory Building Used for Warehousing.

The Lloyd A. Fry Roofing Company was preparing to move into its new plant at Summit and was in process of shifting equipment from its previous location. The Firestone Tire and Rubber Co. was using the facilities of the uncompleted structure (pending the transfer) for the storage of combustible merchandise and paper cartons. The building was a large, unsprinklered, skeleton steel structure, 1000 ft. long by 130 ft. wide, 18 feet high at main roof line. The corrugated metal walls and roof had been coated with a mixture of pitch and asbestos fiber. On the day of the fire, a partially loaded railroad box car was adjacent to the loading platform. Employees of the Firestone Co. improvised a salamander (consisting of a punctured oil drum stuffed with paper and crating) and placed it inside the box car to provide heat. Why they elected to adopt this makeshift method is not clear, especially inasmuch as fire-safe salamanders were available. One of the workmen discovered the interior of the car

ablaze at 1:15 P.M. Shouting to others, they attempted to extinguish the blaze without calling the fire department. A strong wind, however, blew hot coals and sparks through the loading doors into the building and in a matter of a few minutes the cardboard cartons and combustible merchandise were fully involved. Fry Co. employees, attracted by the fire, called the local department at 1:30 P.M. (15 minutes after detection). Local volunteers responded and help was also called from three neighboring communities. Unprotected structural steel members over the storage area buckled under the heat, with most of such damage confined to an area approximately 200 ft. by 130 ft. One report indicates that the protective coating on the metal contributed to the spread of the fire and that its tendency to melt and drip at temperatures below the ignition point influenced the amount of loss. Another report indicates that the coating aided in preventing the spread of fire and that while the coating melted, the droplets burned out before reaching the floor. (This feature of the fire is being further checked by the N.F.P.A. Executive Office.) Firefighters were hampered by the lack of sufficient water supplies to extinguish the burning combustible stocks, but were able to place three lines in service to check the spread through the remaining portions of the building. Estimated structure loss, $150,000; merchandise, $300,000; total, $450,000.

Jan. 25, 1947, Madison, Fla. Tobacco Warehouse.

A carbon disulphide explosion and fire caused heavy structural damage to the American Sumatra Tobacco Corp. tobacco warehouse as customary fumigation operations were in progress. The building, a 3-story, brick, ordinary wood joist structure with a ground floor area of 6,200 sq. ft., was protected by a single source automatic sprinkler system. The blast did not materially damage the sprinkler system, which was a major factor in controlling the resultant fire until finally extinguished by the fire department. No casualties were sustained, as employees had been evacuated from the building in view of the hazardous properties of the fumigant. Other precautionary measures included disconnecting electric, heat, and telephone service, sealing doors and windows, roping off and posting the building. Source of ignition is unknown. Fire, water and smoke damage on stock alone equaled $500,000; structural damage, $20,000; total: $520,000.

Jan. 30, 1947, Tacoma, Wash. Flour Mill.

With the sprinkler valve closed at the start of the fire in the building of origin, and the primary water supply source seriously impaired, hope of saving the combustible mill, warehouses, and elevator of the Centennial Flouring Mills Company was very slim. To appreciate the fire protection problems presented, the following significant factors have been briefed from the excellent report on the loss provided by the Washington Surveying and Rating Bureau:

(1). The entire plant was of frame construction occupying an area 600 ft. long and from 55 to 110 ft. wide, with the exception of a fire-resistive addition in course of construction and some small utility structures. The frame buildings, comprising one fire area, ranged from 3 stories (38 ft.) to 7 stories (156 ft.) in height. The grain elevator was the oldest building (1888). The flour mill unit was built in 1903 and adjoining and communicating mills and warehouses were constructed during the intervening years. The plantsite was on a narrow strip of land crowded against the railroad tracks and Commencement Bay on one side, and a high steep bluff on the other with access limited to one roadway.

(2). Private protection consisted of 2-source automatic sprinkler systems (two 4-in. wet pipe systems in the flour and feed mills, twelve 5 and 6-in. dry pipe systems in other structures) without supervisory service. Water motor gongs were installed for each system, but no outside control valves were available because of the confined limits of the plantsite. While the sprinkler system in the flour mill was turned off (reason unexplained) at the time of the fire in this building, other systems in exposed structures operated properly (alarm gongs sounding throughout the plant seven minutes after arrival of fire equipment).

(3). Water supplies consisted of one primary and 2 secondary sources which should have provided ample quantities at correct pressures for the sprinkler systems. Unfortunately, however, the primary (public) source, which was designed to deliver 6,000 gpm at 12 psi residual pressure at highest sprinklers in the elevator, was seriously impaired by a year-old "temporary" condition. A 10-in. main crossing under the railroad tracks had been found defective and the Tacoma Water Dept. had isolated this portion, with the result that the static pressure which should have been 175 psi at grade actually was 30 psi when the first pumper connected to the nearest hydrant. It was not until 30 minutes after the first alarm, too late for hopes of fire control, that the valve isolating the vital link referred to above was opened to restore it to emergency use. Secondary supplies consisted of a 1,500 gpm and a 1,000 gpm electric pump drawing from 100,000 gal. storage tanks. These pumps were set to start

A closed sprinkler valve was the principal factor in this $2,800,000 fire in the Centennial flour mill, Tacoma, Wash., Jan. 30, 1947. Manual fire fighting was complicated by the location. A high bluff (left background) interfered with approach from the rear, and the fire boat was out of service until the fire had been burning 2 hours.

at 75 psi and to shut off at 125 psi. They operated properly until one was manually closed to conserve water in event the exposed property became involved.

(4) Public protection was from the city of Tacoma Fire Dept., and response consisted of 9 engine companies, 3 truck companies, one fireboat, one Navy fire barge and 4 private tugs. Factors limiting the utility of the protection facilities provided included the unfortunate fact that the fireboat was out of service prior to the fire, and, despite emergency repairs and prearrangements, could not be placed in service for 2 hours following the outbreak of fire. This was especially serious as land fire fighting was handicapped by the inaccessibility of the plant, while the bay offered excellent opportunity for "close-in" fire fighting. Land activity was curtailed by the approach problems, the long lines of hose which had to be laid by hand, the inaccessibility of the structures from the bluff as well as from the level, the low water pressures available during the first 30 minutes of fire fighting, and the ineffective streams which could be supplied by the domestic hydrants above the bluff (a residential area).

Favorable circumstances were much more limited. Weather and wind conditions helped, as fire-fighting operations could be conducted without serious handicap or discomfort to firemen and the direction of the wind tended to protect exposures. Reinforced concrete grain tanks and a fire-resistive elevator protected other frame buildings of the neighboring mills on the only exposed side.

The cause of the fire was known to have been the "explosion" of two oil circuit breakers on a 2,300 volt synchronous motor located on the first floor of the flour mill and used as the source of power for the machinery therein. This motor, manufactured prior to 1900 and installed in the plant in 1903, was known to have been hazardous and plant management had had a replacement on order for several months. The plant electrician had noted, just before the oil circuit breaker explosion, that the commutator of the exciter was sparking and had attempted to relieve the trouble by holding a rag against it. This action decreased an already reduced exciting current and the overheated breakers could not handle the overload surge. Efforts made by the plant employees to extinguish the fire with a hose line from a standpipe in the adjacent warehouse were to no avail and, in the excitement, they failed to transmit a fire alarm. Valuable minutes were thus lost until flames, coming up through unprotected vertical openings attracted the attention of an employee on an upper floor and he pulled a manual box alarm (7:57 A.M.). Fire apparatus arrived at 8:00 and a second alarm was immediately sounded.

The progress of the fire was so rapid that it is considered fortunate that all employees escaped without loss of life or injury. The sprinkler operation in units adjoining the flour mill unquestionably contributed to the safe escape of some of the occupants and retarded the fire slightly despite the unsatisfactory water supply available.

The loss has been estimated at $2,500,000 direct damage to buildings, equipment and stock and about $300,000 use and occupancy.

Feb. 4, 1947, near West Bend, Wis. Woolen Mill.

Located outside city limits, the West Bend Woolen Mill lacked public protection. Private fire protection facilities were limited to automatic sprinklers supplied by two 5000-gal. tanks on roof and steam jets in picker bins, and a pumper landing providing access to a mill pond for hose stream water supplies. There was no approved watchman service. The plant, covering a ground area of 26,000 sq. ft., was of mixed construction, roughly 40 per cent wood frame and 60 per cent brick and hollow concrete block. Communicating openings between the frame and masonry sections were protected, although some installations were non-standard, the chief shortcomings being wood sills and inferior hardware on single tin-clad doors. Fire division walls were parapeted to protect the ordinary wood plank roofing on open wood joisted framing. At 12:45 A.M., one of 2 employees of the night shift remaining in the plant detected the odor of smoke. Investigation proved that fire heavily involved the spinning room on the second floor. Finding his way to the office telephone blocked by smoke, he drove his car a half mile to the nearest phone. The fire department received the alarm at 12:58, reached the plant over snow-covered roads

Woolen Mill, West Bend, Wis., Feb. 4, '47.

about 1:15, and was delayed getting water on the fire 15 additional minutes because snowdrifts blocked the pond's pumper landing. In the meantime a 60 mph wind was whipping the fire through the structures, and flames leaped the parapets to carry the fire over the wood roofs. Inside, the fire by-passed the non-standard fire doors and traveled up unprotected vertical openings to ignite the large quantities of combustible contents and to destroy much valuable machinery. Firemen were forced to concentrate on saving the adjoining and detached frame warehouses, and their efforts in this direction were rewarded despite a 12° below zero temperature and the high winds. Raw stock saved was valued at $30,000, By 5:00 A.M., however, the main buildings were totally destroyed, 85 employees were thrown out of work, and the discovery had been made that the loss was only partially covered by insurance. The only theory advanced as to the cause of fire is that a high tension wire struck the metal smoke stack guy wires, setting the roof afire. Loss estimates vary from $262,000 to approximately $500,000; our estimate, $350,000.

Columbia, Pa., Town Hall, Feb. 19, 1947.

First Unitarian Church, Georgetown, Ky., Feb. 10, 1947.

Feb. 10, 1947, Georgetown, Ky. Church.

Fire, originating from an overheated or defective gas furnace, gutted the First Christian Church of Georgetown, leaving only parts of the brick exterior walls standing. A college student first noticed smoke issuing from the church at 2:00 A.M. Although he, with several other students, entered the building and attempted to check the flames issuing from the basement, the fire quickly went beyond control. When the local volunteer department arrived the entire structure was involved and help was summoned from Lexington. The wood-topped steeple crashed into the flaming interior after flames raced through the chimney-like tower. Three other exposed buildings became involved, but firemen and volunteers succeeded in extinguishing these flames at incipiency. A high-valued recently installed organ and carillon were lost in the blaze as well as an old silver communion service and other furnishings and equipment. Loss: $280,000.

Feb. 19, 1947, Columbia, Pa. Municipal Bldg.

A 72-year-old landmark, Columbia's Town Hall, was reduced to ruins by a fire which originally could have been controlled by a hand extinguisher had one been available. Instead, the fire went beyond the control of local fire fighters and help from six nearby communities. Delayed alarm, delayed response and inadequate fire equipment were responsible.

The operator of a small clock repair shop who lived in the rear of his shop was awakened at 6:45 A.M. by the smell of smoke and found his bed clothing aflame. Apparently the bedding had come in contact with an ordinary electric heater being used at the time. After unsuccessfully attempting to extinguish the blaze by beating the flames with his hands, he

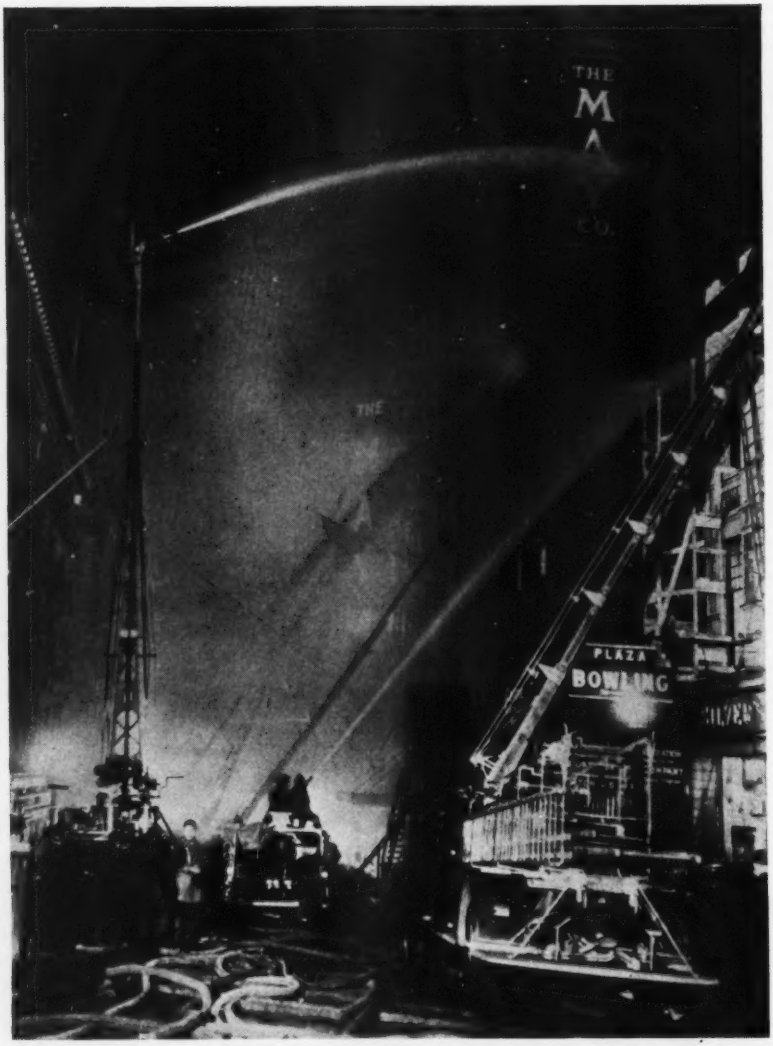
ran for help. By that time a passer-by also had discovered the fire and ran to the nearby fire station to give the alarm. No one was on duty. After some further delay, the electric siren atop the engine house was sounded and this alarm brought the response of the volunteer department. The original blaze in the shop was quickly extinguished, but flames had crept up through the concealed spaces of the wooden partitions of the 3-story brick structure to break out in the 140-ft. clock tower. By the time a water tower was improvised through the use of an aerial ladder, the entire base of the tower was enveloped in flames. A sharp north wind not only fanned the fire, but was strong enough to reduce some of the water streams to mere spray. The tower soon toppled and the flaming embers fell through the roof. In addition to the borough offices, the building housed a large auditorium, the police station and jail, 3 shops, a pool parlor and a state liquor store. The building itself was totally destroyed as were most of the contents, including important borough records. Loss: $307,000.

Feb. 20, 1947, Los Angeles, Calif. Perchloric Acid Explosion.

Seventeen persons were killed and more than 130 injured when a shattering explosion demolished the one-story brick-joisted plant of the O'Connor Electro-Plating Corp. and either wrecked or damaged 28 neighboring buildings, including 24 dwellings, 3 one-story brick mercantile buildings and a frame church. Interior partitions were damaged and windows broken in structures within an area of 12 city blocks. Fire that broke forth in the building of origin

Acme.

Perchloric acid explosion, Los Angeles, Feb. 20, 1947. Seventeen dead, 130 injured, property loss $2,000,000. Exterior damage resulted in buildings in background of this picture and other structures within an area of 12 city blocks.



Press Association.

Large department stores have had a good fire record over the years, thanks to the general installation of automatic sprinklers. However, in the May Co. store, Baltimore, on Feb. 24, 1947, unsupervised sprinkler valves were found closed, and a loss of $1,500,000 resulted. Fortunately the fire occurred after the store was closed, eliminating any question of life hazard to customers. Another favorable factor was that stairways and elevators were enclosed, and there were no open escalators. The loss, while large, was only a small part of the total value of the property.

did some additional damage. Rapid work by gas company employees prevented ignition of escaping gas in other affected properties.

THE PROCESS.

At the time of the explosion the plant was engaged in a new method of electrolytic polishing of aluminum which removed the outer film of metal electrically, leaving the surface bright. The process involved the use of an electrolyte consisting of 300 gals. of perchloric acid-acetic anhydride solution. This mixture was placed in a steel, plastic-lined vat, 6 ft. long, 2½ ft. wide and 3½ ft. deep, in which the aluminum was suspended in a metal basket during treatment. The tank contained a plastic screen to catch any parts that might fall from the basket. On the previous day a plastic rod had been introduced to hold this screen near the bottom. According to statements of survivors aluminum fountain pen caps, after machine work under oil, were cleaned, placed in a basket (which acted as the cathode) and lowered into the perchloric acid solution.

The process was installed and operated under the supervision of an alleged chemist, who, it was subsequently determined, had not had the technical training and university degrees which he claimed. The process had been in use for 4 days when, about 9:45 A.M. on Feb. 20, the vat started to heat violently. A refrigeration system, designed to prevent heating, was not in operation at the time.

The "chemist" and a helper were approaching the vat when it exploded, presumably due to the disintegration of perchloric acid which, in addition to being a powerful oxidizing agent, is subject to explosive decomposition when heated. The explosive effect was said to be similar to what might have been expected from the explosion of 1½ tons of nitroglycerine. The blast left a hole 8 ft. deep and 20 ft. in diameter beneath the spot where the vat had stood on a 4-in. earth-supported concrete floor. Disintegration was so complete that no identifiable part of the vat or of the bodies of the "chemist" and his helper could be found.

It is known that organic material will react violently under certain conditions with perchloric acid. The most plausible theory, as indicated by expert testimony at the coroner's inquest, was that the acid solution became contaminated by organic material, probably the recently installed plastic rod. An exothermic reaction took place, which heated the perchloric acid to the point of explosion. Loss: $2,000,000.

Feb. 24, 1947, Baltimore, Md. May Department Store.

A series of four incendiary fires ultimately caused heavy fire, smoke and water damage to the May Company after automatic sprinkler protection played the role of a hero on two occasions and then was denied water to finish the job. The property was a large department store, housed in a 9-story fire-resistive main building and a 7-story annex connected by a bridge. Reports received from Chief Travers and other sources give the following sequence of events:

(1). At 6:34 P.M. a watchman pulled a manual alarm box after hearing a local sprinkler water-flow gong. Firemen answering the call found a small fire on the fifth floor on the interconnecting bridge between the Main and Annex Buildings. Three sprinklers had extinguished this fire, which was confined to packing materials in an open box. The sprinkler valve controlling the heads on this bridge (separate riser) was shut and salvage work started.

(2) At about 6:39 an employee notified firemen of a second fire in a mailing room in one corner of the 10,850 sq. ft. fifth floor area of the Annex. Here again, the operation of one sprinkler was controlling the fire when firemen reached the scene. A soda-acid extinguisher was used to finish the job. Efforts to stop the sprinkler discharge in this case were unsuccessful and attempts to locate the proper valve were still in progress when the third fire was reported.

(3) A member of the incendiary squad discovered the third blaze on the same floor but in the Main Building. No sprinklers were operating and an attempt to use a standpipe hose revealed that no water was available.

(4). A fourth fire was then discovered a short distance away on the same floor. A second alarm was immediately ordered and firemen brought hose lines from other standpipes while responding pumpers connected two lines from high pressure hydrants to the siamese pumper connections at the street level. Efforts to open the closed sprinkler valve on this floor by both firemen and the store engineer (who had been called to the scene by telephone) failed as the fire gained momentum so rapidly that they were driven from the area.

From this time on flames swept the entire floor area of 14,000 sq. ft. feeding on the combustible stock, decorations, carpets, rugs and trim. Factors tending to limit the spread of fire to other floors included enclosed stairwells and elevators with protected openings and the substantial floor construction (hollow tile on

protected steel frame with wood overlay). Fortunately there were no escalators in the building, which would have exposed other floors. Damage to lower floors was occasioned, however, both because fire and heat traveled down hollow columns to mushroom out at lower floor levels to destroy cement bonding of the flooring and ceiling plaster and because of water seepage down stairwells and elevator shafts and through the hollow tile walls (floors not having wall scuppers for drainage). Horizontal spread to the Annex was prevented by operation of rolling steel fire doors installed at both ends of the interconnecting bridge, although the Main Building end door had to be reopened to permit the escape of two trapped employees and was not reclosed.

Fire fighting was restricted to outside hose streams after the fire drove firemen from the floor. At the height of the blaze eleven 2½-in. streams were used from a neighboring three-story building plus hose lines and high pressure water towers from the street level. An estimated 800,000 gallons of water were poured into the structure.

Following final extinguishment it was discovered that the control valve on an 8-in. connection to the public main and the main sprinkler system control valve, both located in the basement, were shut off as well as the sprinkler valve on the fifth floor. It is unknown how these valves were shut, who did it, and when they were closed. It was obvious that no one on the premises checked other than the fifth floor valve after the third and fourth fire broke out, indicating a lack of thorough knowledge of sprinkler equipment. While it cannot be overlooked that the arsonist who started the fires might have also committed the acts of closing the valves, it would appear peculiar that he did not also shut the valves in the Annex and Bridge to prevent sprinkler operation in those fires.

The loss is estimated at $1,000,000 fire, water and smoke damage and $500,000 business interruption. Total: $1,500,000.

Mar. 4, 1947, Westboro, Mass. Group Fire—Industrial.

The weak water supply in the vicinity of the Westboro Industries plant and the Westboro Underwear Company was well known. Tests made in 1944 showed that a flow of 600 gpm. reduced the available hydrant pressure from 47 lbs. to 5 lbs. There had been no improvement since that time, although a new high pressure system was planned for 1947. The buildings occupied by these 2 concerns were both 4-story wood frame, plank on timber structures provided with automatic sprinkler protection (1896 pipe schedule). The Westboro Industries plant was occupied by the Wheatly Products Company (reclaiming sisal

A weak public water supply, which had been known for years to be seriously defective, the sole supply for automatic sprinklers in this 4-story wood frame building, was responsible for the failure of sprinklers to control this fire in Westboro, Mass., on March 4, 1947. Loss: $700,000.

Walgreen Drug Store fire, Memphis, March 6, 1947. Loss: $475,000. Combustible interior construction, unprotected vertical openings, no sprinklers.

and jute fiber from old rope and rope waste), and 4 other tenant manufacturers. At 2:30 P.M. an employee noticed smoke in the picker room and immediately sounded a local alarm and telephoned the public fire department. Employees attempted to locate the source of fire, but increased smoke drove them to open windows. Flames were then observed to be coming from a picker machine. It was also obvious that the fire was not being controlled by the water from at least 16 sprinkler heads or by the fire extinguishers which were being used. When the public fire department connected its first 2½-in. hose line, the sprinkler delivery dwindled to mere drops. Flames then quickly spread out of control and involved the entire main building (175 ft. by 40 ft.), and the wing (48 ft. by 29 ft.). Local fire fighters, aided by fire fighters from 10 surrounding communities, concentrated on protecting the adjacent frame factory (185 ft. by 40 ft.) of the Westboro Underwear Co., but the lack of sufficient water and adverse wind conditions defied their efforts. Radiated heat and flying embers ignited the combustible exterior walls and roof while interior sprinkler and outside water curtain protection was of no avail because of absence of water. A filling station across a 50 ft. street, 3 automobiles, a dwelling and garage as well as electric power and telephone lines in the vicinity were also destroyed. Final control was not secured for 4 hours. Adequate hose streams were secured only after pumpers took suction from brooks a mile or more away from the scene and used relays to boost pressures. The cause of the fire was believed to be foreign material in the picker, which caused a friction spark and ignited jute. Two other fires within the past 4 months in this room had been controlled by sprinklers. The management had decided to remove the operation to a cut-off area, but this had not been done. Loss estimated at $600,000, property damage; $100,000, business interruption; total $700,000.

Mar. 6, 1947, Memphis, Tenn. Drug Store.

The Walgreen Co. occupied an area of 11,100 sq. ft. on the first and basement floors of what were originally 3 adjoining buildings. The structures, built about 1900, were typical 4-story brick, ordinary wood-joisted structures without sprinkler protection. Stairwells were open from the basement to the first and from the first to the top floor, and the elevator shaft had only a frame enclosure. The retail drug store was typical of such large chain outlets, with quantities of high valued merchandise on counters and display shelves as well as reserve stocks in basement storage areas. Upper floors were not used. Cleaning women discovered the fire, which originated in the basement about 3:55 A.M. After an unsuccessful attempt to use the telephone they attracted the attention of

Associated Press.

This warehouse fire, in the shadow of the Manhattan Bridge, New York City, caused a loss estimated at $500,000 on March 13, 1947.

outsiders, who gave the first alarm by telephone. Even as fire fighters reached the scene, flames had spread upwards through the elevator shaft to involve all 4 floors of the undivided buildings and 3 other alarms were sounded at 4:02, 4:14, and 4:45 to bring a total of 14 engine companies plus auxiliary units. Twenty-five major hose lines were required to extinguish the flames. Firemen had some trouble reaching the fire with hose streams from the rear of the structures as many windows had been bricked up and others were equipped with closed metal fire shutters. Unprotected vertical openings and the lack of automatic protection provided obvious lessons in this fire. The cause is attributed to a cigarette disposed in an open trash container in the basement adjacent to the elevator shaft. Building damage is estimated at $250,000 (walls to be razed). Fixtures and stock loss is estimated at $225,000. Total: $475,000.

Mar. 13, 1947, New York, N. Y. Terminal Warehouse.

A 5-alarm fire swept an old 5-story warehouse building, destroying large quantities of relief clothing destined for Poland, chemicals, and pharmaceutical supplies. The fire apparently originated near the center of the third floor and spread via open stairways at each end of the 50 ft. by 200 ft. brick, wood-joisted building to the other floors. Heavy smoke and fire were showing at windows of all floors above the first as fire equipment reached the scene at 7:46 A.M. Absence of automatic alarms or sprinklers thus severely handicapped fire fighters as the delay prevented entrance to the structure for internal suppression activity. Fire boats supplied two tower streams and deck pipes as nineteen pumper companies provided 2½-in. hose lines from the street and from windows of exposed structures. Loss estimated at $500,000.

Mar. 23, 1947, Beaver Dam, Pa. Paper Manufacturing.

The sprinkler system installed in 1892 in the West Disinfecting Company plant failed to control a fire attributed to an overheated bearing on a paper machine. Rapidly spreading flames in "fly" and dust were first detected by an employee at 2:45 A.M. around the gear drive of the machine on the ground floor in the machine room. Employees immediately connected 2½-in. hose lines to available plant hydrants, started fire pumps in the boiler room, and sounded the mill and public fire alarm. Fire spread throughout the ground floor and to the basement of the single story and basement structure despite the weak sprinkler discharges which were observed on both floors. Fire also traveled through unprotected window and door openings to the adjacent, sprinklered beater room. A ventilating fan in the plank, wood-joisted roof further intensified the fire. At about the same time, the boiler room became totally involved as fire traveled down a power shaft and falling walls knocked out the fire pumps. Five volunteer fire departments from four surrounding communities were at the scene within 30 minutes and they used 20 hose lines in attempts to bring the fire under control. The only public water supply available was from nearby creeks, ponds and a head-race. Final extinguishment was not secured for 6 hours. Fire doors protecting openings to the stock room operated to prevent further loss. Defects with the sprinkler system which accounted for their failure included: (1) obstructed piping; (2) poorly spaced sprinkler heads (especially under metal hood over paper machine); (3) substandard pipe sizes; (4) inadequate fire pump capacity and its failure under fire exposure; (5) rapid emptying of the 17,500-gallon gravity tank. Loss: $282,000.

Wetting Agents.

At the 1946 annual meeting a paper entitled "Wetting Agents in Fire Extinguishment" was presented by Norman J. Thompson, Director of the Factory Mutual Laboratories (*Proceedings* 1946, page 69). Since that time there has been an increasing interest shown in the use of wetting agents, and articles published in popular periodicals have stimulated attention to this subject. Thus far, however, the record of field experience in the use of wetting agents has been meagre. Some experimental work has been done and good results with the use of wetting agents have been reported in a few specific instances, but there is not as yet sufficient information available to permit any complete evaluation of the use of wetting agents in fire fighting.

Since the publication of Mr. Thompson's paper, the Factory Mutual Laboratories have given further attention to this subject and have released the following bulletin giving information on certain limitations in the use of wetting agents.

Limitations of Wetting Agents.

The following information is given to supplement the paper entitled "Wetting Agents in Fire Extinguishment" presented by Mr. Norman J. Thompson, director of the Factory Mutual Laboratories at the 1946 annual meeting of the National Fire Protection Association.

Since June 1946, the Laboratories have made additional tests on several commercial wetting agents and have been surprised to find little or no improvement in the fire extinguishing action when applied to such materials as paper and excelsior. An interesting conclusion from the test work is that research is needed to develop an effective wetting agent without objectionable foaming characteristics.

Soda-Acid Extinguishers.

The tests indicated that the use of solutions of wetting agents in soda-acid extinguishers is impractical if the solution is used in effective wetting concentration. Excessive foaming slows down the rate of discharge, and causes the extinguisher stream to spray badly, seriously affecting the stream range and the effectiveness of the unit.

Gas-Cartridge Pressure-Type Extinguishers.

It was also found that the addition of wetting agent to the charges of 2½-gallon gas cartridge pressure-type extinguishers is not desirable since the effective range is reduced approximately 25 per cent, and the latter portion of the liquid in the extinguisher was discharged partly as a solid stream and partly as a spray. Comparative fire tests indicated that this extinguisher was less efficient when wetting agent was added to the charge.

Pump Tanks.

Comparative tests made with a 2½-gallon pump tank extinguisher indicated that the discharge time was appreciably increased and the effective range was reduced by about 12 per cent when a wetting agent was added to the charge. Fire tests for most agents tested indicated that the extinguisher was no more efficient when a wetting agent was added to the charge than when charged with plain water.

Preliminary tests show that the corrosive action of water on steel containers is accelerated considerably when commercial wetting agents are added to the water. Consequently, it would be necessary to protect a steel tank with an asphalt or other coating just as is done for calcium chloride non-freeze solution.

Principal Application.

Apparently the principal application of wetting agents in water to existing fire extinguishing equipment would be in small hose streams from pumper-mounted tanks such as those used for fighting brush fires with moderate pumping pressure of not over 100 p.s.i. Below 100 p.s.i. the stream range is not seriously affected, although a change in range is noticeable.

Conclusion.

At the present time, considering the cost and some complications in the use of wetting agents,

such as corrosion, long-time stability and the disappointing action on some common combustible materials, the Factory Mutual Laboratories are not recommending the use of specific wetting agents for fire extinguishing purposes.

Such field experience as has been reported to the N.F.P.A. indicates that wetting agents may have an important field of usefulness, particularly in forest and brush fire fighting, where they permit rapid wetting of dry leaves and forest litter which are not quickly penetrated by the ordinary stream of plain water, thus permitting the more rapid controlling of a fire line and presumably greatly reducing the work involved in holding a line, which often involves the laborious work of trenching down to the level of mineral soil. Another advantage that has been cited is that the use of a wetting agent will result in quicker saturation of the fibres of unlined linen forestry hose. Such hose, when water is first passed through it, leaks to a considerable extent and some time elapses with plain water before the fibres swell sufficiently to be reasonably water tight. With long lines of such hose, as are often used in forest fire fighting, this may be an important factor.

The suggestion has been made that the problem of possible corrosion of water tanks on fire apparatus due to the use of wetting agents might be solved not by storing the solution to the tank, but by introducing the wetting agent into the pump discharge line by means of a proportioner especially designed for this purpose. However, up to the present time the N.F.P.A. office has not been advised that any proportioners suitable for such use are commercially available. Where the service of the fire apparatus is such that the water does not stay in the tank without use over a long period of time, the problem of corrosion may not be serious. Where it is considered a factor, it may be practicable to introduce a wetting agent solution into the tank at the time of fire.

There are a large number of wetting agents having differing properties, and presumably having varying degrees of suitability for fire protection use. Many of these wetting agents developed for altogether different purposes may be found unsuitable for fire protection purposes. Attention is also directed to the previously reported fact that various dissolved salts normally present in water supplies may have important effects in connection with the use of wetting agents. This indicates that a wetting agent found suitable for use with one water supply will not necessarily give the same results with other water supplies.

Field experience and further research should in time provide the basis for more exact conclusions as to the desirable uses and limitations of wetting agents in fire extinguishment.

Deductions from Research on Use of Water.

By H. Adeler, Chem. Eng., M. Sc.,
Danish Fire Protection Committee (Member N.F.P.A.).

In recent years increasing attention has been paid in Europe to the most effective use of water for fire extinguishment and to prevent too great water damage. Progress has been made in fire fighting techniques which, combined with stringent laws for building construction, have made inside fire fighting possible to an increasing extent. This has also demonstrated that it is possible to quench fires with very small quantities of water. Experiments have been conducted in various countries in Europe to illustrate the possibilities in the use of smaller streams and nozzles than have been hitherto used.

The combustibility of buildings themselves has been a handicap to inside fire fighting methods in the U. S. and Canada, where stairs, floors and interior partitions are frequently of wood and where even buildings with brick walls are often faced with combustible inner walls. Such conditions, in certain buildings, have made outside fire fighting with massed fire streams from deck guns and water towers a matter of necessity rather than choice. Yet, even under such unfavorable conditions, inside fire fighting is favored. Widening use of small lines and self-contained breathing apparatus make it increasingly possible. So does the trend to safer building construction of the types well established in Europe which have heavy floors and incombustible walls and partitions.

Caution is advised in drawing broad conclusions about the use of hose streams from small test fires. In spite of the fact that large fires introduce variables not present in small laboratory fires, the practical experience here in Europe corroborates the results and conclusions described.

Amounts of Water Required.

Water for fire extinguishment was a serious problem before the machine age and in a day when building construction was predominantly combustible and dangerous. Waterworks with hydrants and steam fire engines marked a great step forward. It was not until the time of automobile fire engines and more prudent building construction that fire departments began to show superiority to ordinary fires. It became increasingly possible to make inside attacks on fires while they were still small and to quench the fire with quantities of water much smaller than, up to then, had been thought required.

The use of smoke respirators (ordinary gas masks) was another step forward. A turning point was reached, however, with the advent of "smoke divers." In Denmark this name is applied to firemen equipped with self-contained breathing apparatus who can make their way to the seat of a fire in spite of oxygen deficiency and heat.

Povl Vinding, Dr. techn., present fire chief at Copenhagen, is a pioneer in the use of "smoke divers." They always respond on first alarms, and great peacetime fires have been rare in Copenhagen. In fact, because of these and other modern methods, fire departments have, on the whole, mastered peacetime fires. (War-

time fires are something else. The war showed that we are not very far from the middle ages when fire brigades are helpless.)

As fire-fighting services began to get the situation under control, speculation began about the quantities of water actually needed and how to transport them. In old textbooks the classical calculations are found:

1 kilo wood develops 3000 calories.
1 liter water consumes 600 calories by evaporation.

(In English units:
1 pound wood develops 5.4 British thermal units.
1 U. S. gallon water consumes 9 British thermal units by evaporation.)

According to this, 5 liters of water must be thrown per kilo of wood (0.6 U. S. gallons per pound). In practice, that would mean considerably more, because all the water could not be used. But, as will be shown, this calculation does not hold. Ordinarily, conditions are much more favorable.

Certain authors maintain that the mechanical effect of the jet was equal to the extinguishing effect. But this view is not correct either.

In Austria, the question was brought up by Stanzig, later deputy fire chief of Vienna. This is how he put it:

The specific heat of charcoal is 0.2; consequently charcoal with a temperature of 1500° C. (approx. 2700° F.) contains 300 calories per kilo (0.54 Btu. per lb.), which means that 0.5 liters of water must be supplied per kilo (0.06 U. S. gal. or about ½ pint per lb.) of charcoal. Moreover, each square meter radiates 3000 calories per minute so that 0.5 liters of water must be applied per minute per square meter, or 500 liters per minute per 100 square meters (about 120 U. S. gals. per min. per 1000 sq. ft.) of fire area. The operational area of a jet or stream may suitably be fixed at 100 square meters (1076 sq. ft.) and consequently a "standard" jet or stream should carry 500 liters per minute (about 130 U. S. gals per min.).

As for pressure, experience with impregnation of wood was drawn on. A pressure of 8-10 atmospheres (120-150 lbs. per sq. in.) is required to press a liquid into wood. From this it was reasoned that jets should have a pressure of 8-10 atmospheres at impact.

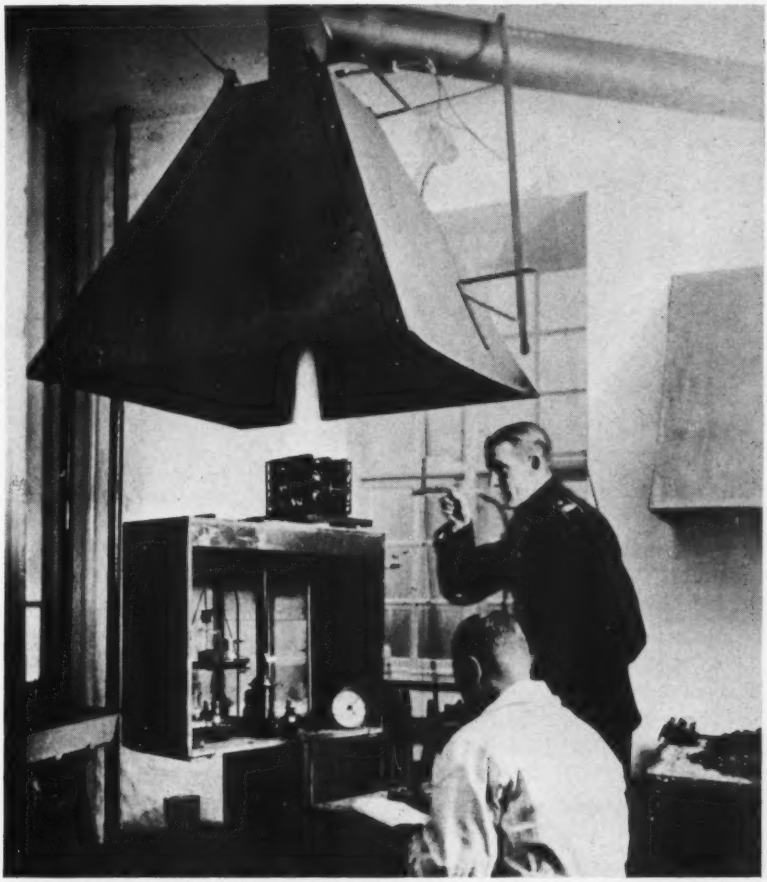
These conclusions: small water supply, but high pressure, led to the Vienna practice of pumper pressures, 2-inch hose lines. Small nozzles were used, each equipped with a manometer (pressure gauge), the readings of which the operating fireman was to watch carefully.

Chief Folke's Experiments.

In Denmark, the late fire chief of Copenhagen, Anders Friis, caused some investigations to be started in 1931 by the Danish Fire Protection Committee. They were conducted by Chief Folke of Fredericksberg, assisted by Deputy Chief Mygind and the author of this paper. Part of the results were published in an article, "Experiments in Fire Extinguishment," in the QUARTERLY (October, 1937, Vol. 31, No. 2, page 115).

Chief Folke's procedure placed a pile of sticks on a weighing machine. It was therefore possible to observe with accuracy the course of the fire and the effects of extinguishment. By an interesting coincidence a similar method was in use at the Forest Products Laboratory in Madison, Wisconsin, for the examination of impregnation agents. This was Truax and Harrison's fire-tube method.

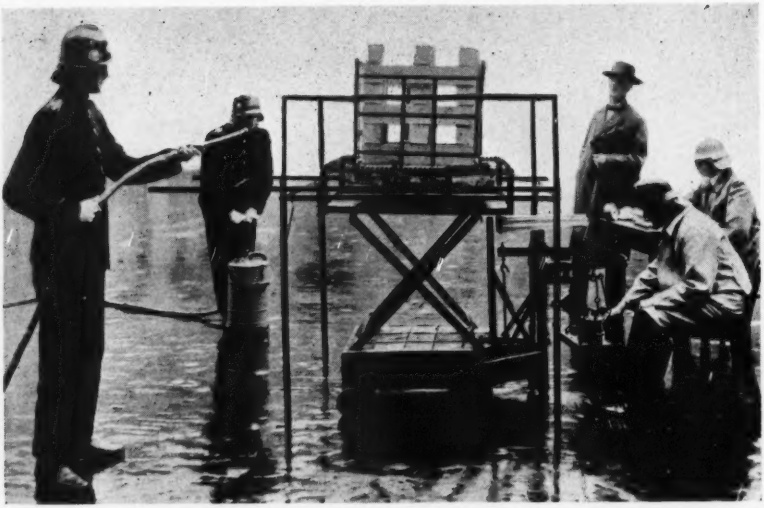
Chief Folke made also a number of ex-



Some fundamentals of combustion and extinguishment could be learned from simple, inexpensive laboratory experiments which may be repeated at will (Folke's weighing method, 1931).

periments with test piles several times as large as the small piles, which confirmed the results. Consequently it may be expected that these results would hold for larger fires such as those encountered in day to day fire fighting operations. The main results of these tests were:

1. *Wood burns in several distinctly separate stages.* After a short *ignition stage,* during which the wood is dried and heated, the *combustion stage* begins. The outermost layer of the wood develops gas, which leaves the wood as flames or smoke. The layer that gives off gas is quite thin, and the wood inside is still white and intact. Little by little the gas layer works its way into the wood, the white core at the same time growing smaller as the charcoal layer grows thicker. (This is the explanation of why heavy timber members retain their supporting power in a fire for so long a time.) The charcoal layer is certainly

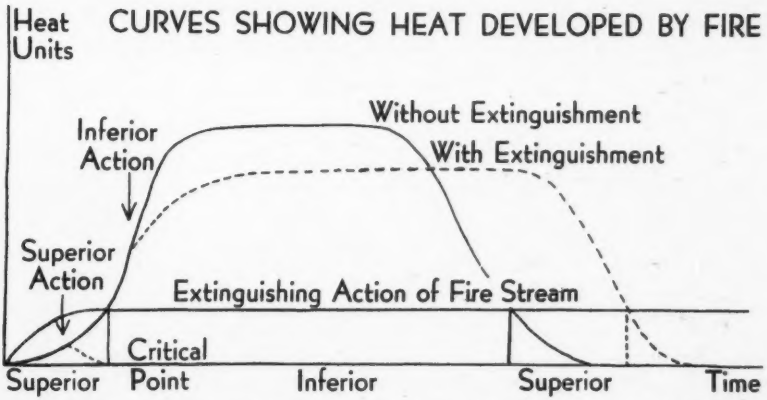


Fire Chief Folke's weighing tests with slightly larger assemblies.

hot, but it is not glowing because the gas coming off prevents the access of air to it. Only when the core has disappeared and the gas development is over does the charcoal begin to burn: the *glowing stage* begins. There are no more flames now, but the charcoal burns brightly and is gradually consumed. During the combustion stage the temperature is not very high, as heat units are being carried away by the gas. However, during the glowing stage, intense heat is accumulated in the wood. For wood of ordinary dimensions, the combustion stage lasts about 10 minutes. This explains why a fire attacked in the first 10 minutes is so much easier to extinguish than it will be later.

2. *The extinguishment of fire in wood, particularly in the combustion stage, requires much less water than has hitherto been thought.* In the experiments a fire developing 180 calories (0.71 Btu.) per minute was put out with a jet stream which could evaporate only five calories per minute. That is only 3 per cent of the quantity hitherto considered a "minimum." The explanation is that it is not the heat *developed* by the fire but that *contained* in the fire which must be extinguished, and in the combustion stage this is quite low. Not so in the glowing stage: then heat remains in the fire, and consequently larger streams of water are required for extinguishment. But in this case, too, smaller quantities will suffice than those required according to the "classical" calculation. The experiments corroborated Stanzig's calculation: 0.5 liters water per kilo of charcoal.

3. *The concept that a high jet or nozzle pressure is required to press water into charcoal is not correct.* Charcoal absorbed water very readily and the gas given off did not appear to hinder this. While it is difficult to press water into fresh wood for impregnation, the impact pressure is of no great importance, as charcoal will absorb water freely. Pressure to carry a stream from the nozzle to the fire, of course, is important, but that is a separate problem.



Curve "without extinguishment" shows heat (against time) in a small test fire and "with extinguishment" as modified when stream is applied. The jet or stream is superior to the fire only up to the critical point and after the fire is largely burned out.

This experience corroborates observations of Chief Fossoult, Anderlecht, Belgium.

4. *The most important result was, perhaps, the demonstration of the difference between extinguishment with a superior jet or stream and an inferior one.* It is important to note that the difference between the superior and inferior jets is very small. If a stream from a nozzle is just strong enough to extinguish a fire, it might be supposed that a jet just a little smaller would save, say, 90 per cent of the fire. But this is not so. During the glowing stage of the fire such a jet would be ineffective. So it is a case of having a stream strong enough to overcome the fire, or nothing.

Elaborations of the Danish experiments have shown that a formula may be worked out for the minimum superior jet as a function of time. This formula holds only

(1) when the scene of the fire is not too large for the jet to control the entire area, and

(2) if the fire is still principally in the combustion stage without large amounts of glowing charcoal or other hot substances.

In other words the formula will apply in the case of the many fires reached in the early (ignition and combustion) stages. It is deduced from the plotted figures on the accompanying chart.

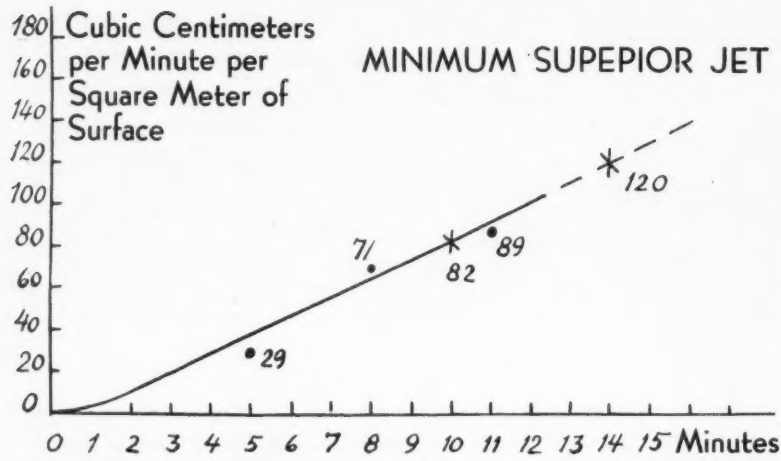
$$Q = \frac{t}{100}$$

Q is in liters per minute per square meter of burning surface, and t is in minutes. (The formula, with Q as U. S. gals. per min. per sq. ft. would be roughly $Q = t/4000$.)

In practice this means that 1-2 liters per minute per square meter (roughly 1-2 quarts per square yard) of *floor area* will produce a fire stream superior to an ordinary fire. If there is already much heat at the scene of the fire, 5 liters per minute per square meter (roughly 1 gallon per square yard) will, as a rule, still be superior.

Vienna Practice.

The results of the Danish experiments conformed to the views of Stanzig. The "standard" jet or stream of 500 liters per minute (130 U. S. gallons) has thus



Deduction of minimum capacity of a small jet or stream on the small test fires. From these a straight-line formula can be developed which may also hold for larger streams or larger fires. At 10 minutes, 82 cubic centimeters per minute per square meter is a big enough stream and 120 cubic centimeters is enough at 15 minutes. These are respectively 2 and 3 U. S. gallons per minute per 1000 square feet when translated in terms of larger streams.

proved to be rather large. In the majority of cases 200 liters per minute per 100 square meters (about 50 U. S. gals. per min. per 1000 sq. ft.) would suffice. Often even half this amount would be sufficient.

On the other hand, a high nozzle pressure was still considered important, 9 to 12 atmospheres (130 to 175 lbs.). This was to obtain good distribution of the water from the ricochet effects. Good distribution was aimed at by very energetic movement of the nozzle pipes. Stanzig said, "The nozzle pipe movement must be just as violent as bayonet fighting."

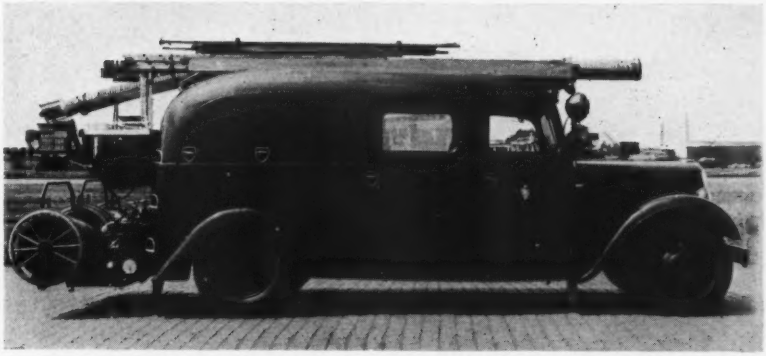
Following this principle, in Vienna it was customary to run out a few light hose lines quickly and after a few minutes the fire would be knocked down in most cases. Other principles and practices observed, as a result, in Vienna were:

(1) Laws enforced to subdivide buildings, particularly those of dangerous occupancy, into fire areas or compartments not exceeding 500 square meters (about 5000 sq. ft.).

(2) In order to assure speedy turnout many small stations were scattered all over the city. The engines were small and light. The cars had a water tank of 560 liters (150 U. S. gals.), pump 250 to 350 liters per minute (65 to 90 U. S. gals. per min.) at 25 to 20 atmospheres (370 to 300 lbs. per sq. in.), 400 meters (1300 ft.) of 2-inch standard hose.

(3) Each squad was equipped to master fires of 250 square meters (2700 sq. ft.). To buildings where areas were greater, additional squads would be sent. Added help could be called by radio.

(4) Each squad could lay five hose lines, each intended to cover 50 square meters (540 sq. ft.). As a rule the streams were used in pairs. The supply to each nozzle did not exceed 250 liters per minute (66 U. S. gals.), generally much less, especially in the case of spray nozzles on



Standard Danish heavy pumper: 2-stage centrifugal pump, 530 GPM at 88 lbs. per sq. in., 92-gallon water tank and booster line, 1300 feet of 2-in. and 3-in. hose, 6 ladders (30 ft. and 13 ft.), crew of 7.

superficial fires. "A larger water supply or a larger operational area only lead to waste of water and water damage," said Stanzig.

In recent years, when smoke divers have made inside attacks possible, there seems to be a strong tendency to use smaller and handier hose lines and light fire apparatus. From being rough work, fire fighting has come to have a degree of precision and a minimum of water damage.

Danish standard fire apparatus carry water tanks and "first aid" hose. These small lines will deal with most fires without the use of heavier hose lines. In Denmark a nozzle pressure of 3 to 5 atmospheres (40 to 80 lbs. per sq. in.) is in general use. This is a compromise. Pressure helps water distribution, but good distribution can be obtained by powerful agitation of the playpipe and by use of spray nozzles. Very high pressures make disproportionate demands on the hose material.

In Sweden, high pressures have come to be used: 6 to 9 atmospheres (90 to 130 lbs.). The stress has been on good striking power and distribution. Various experiments have been carried out by Chief Mohlin in 1936 and by Fire Inspector Brandsjö in 1942 and by Chief Forsmann in 1943. These tests encouraged the use of small hose, showing, for instance, that a pile of 250 kilos (550 lbs.) of burning wood could be extinguished with only 20 liters (a little over 5 gals.) of water in all.

One result is Mohlin's nozzle, which can be attached to 2½-inch as well as 1-inch hose. One-inch hose is often laid out from the 2½-inch hose with a dividing breeching or wye with three outlets. This gives excellent distribution of water. Recently experiments have also been made with fog-extinguishment (Brandsjö's nozzle), but here the pressures are not so high as sometimes employed for the purpose in the United States.

It remains to be seen whether there will be reason to change over to the use of high pressure hose streams, perhaps of the fog type. But it is certain that smoke divers and inside attacks render possible a wider use than hitherto of small, highly maneuverable jets.

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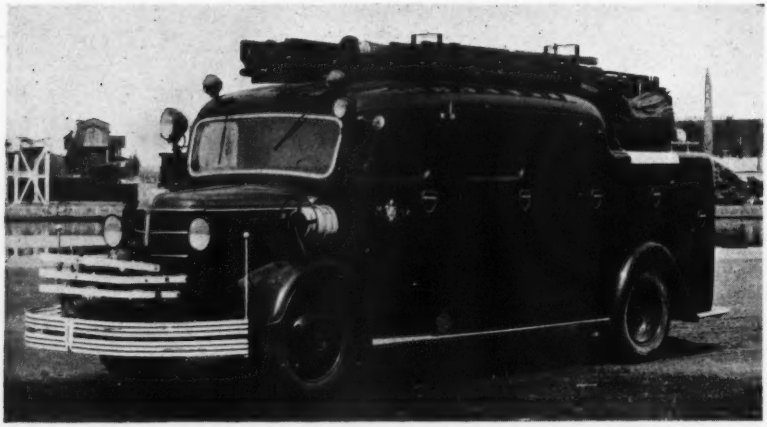

Standard Danish light pumper: front-mounted 2-stage centrifugal pump, 310 GPM at 88 lbs. per sq. in., 92-gallon water tank and booster line, 1970 feet of 2-in. and 3-in. hose, 2 ladders (30 ft. and 19 ft.), crew of 6.

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Fire Record of Cities, 1946.

Fire Department Reports.

Fire departments of 500 United States cities and 50 Canadian cities of over 20,000 population have reported their estimates of fire loss, fire alarms, building fires, and false alarms for 1946 to the N.F.P.A. Department of Fire Record.

A total of 492 U. S. cities having more than 20,000 population reported a fire loss for the year 1946 of $158,883,769, amounting to an average loss per person of $2.90 for the 54,827,881 inhabitants of this group. The 1945 figure was $2.66.

Fifty Canadian cities having a total population of 4,884,567 reported a total loss of $17,709,982 for 1946. This was a per capita loss of $3.64, as compared with $3.42 for Canadian cities in 1945.

A total of 473 U. S. cities reported both loss data and the number of building fires. The average loss per building fire in these cities for 1946 was $654, compared with $640 in 1945. The average loss per building fire for 48 Canadian cities was $670 in 1946, compared with $565 in 1945.

The total number of building fires reported by 473 U. S. cities was 223,862, an average of 4.27 fires per 1000 population, as compared with 4.11 building fires per 1000 population in 1945 and 4.20 in 1944. Fifty Canadian cities reported 25,078 building fires in 1946. The number per 1000 population was 5.15 in 1946, as compared with 5.20 in 1945.

Fire departments in 499 U. S. cities of more than 20,000 population answered 715,308 alarms in 1946. The number of alarms answered by the fire departments in 50 Canadian cities was 49,726.

In the United States, 500 cities of over 20,000 reported 73,814 false alarms in 1946. This was 10.4 per cent of the total calls answered. It will be noted that these are "malicious false alarms" and not just cases where smoke or steam, etc., was honestly mistaken for fire. Fifty Canadian cities reported 5588 malicious false alarms, or 11.2 per cent of their total calls.

The populations of many cities have changed since 1940. However, to keep the data comparable, we have used the 1940 U. S. census figures except in cases where the Census Bureau has issued recent official population estimates.

The N.F.P.A. Department of Fire Record is indebted to a number of our members who were instrumental in helping to assemble these data. Fire departments have been very cooperative in furnishing fire loss figures or giving us estimates where the final figures were not yet available. In very few cases fire departments indicated it was not possible for them to supply the fire loss information.

In a number of cases these are preliminary loss estimates and may be subject to upward revision when end-of-year fire losses are adjusted. Recent experience has shown that fire department estimates of loss based upon normal estimating procedures may be considerably below present-day values that are being reflected in adjusted fire loss payments. Further, many fire departments do not record indirect losses such as use and occupancy.

While there are occasional discrepancies in the manner in which certain cities report losses, our questionnaire calls for the total fire loss, both insured an uninsured, and this is the figure given unless otherwise indicated. Chimney and roof fires have been included in the number of building fires. A few cities do not give a complete record, but on the whole it is believed that these figures present a reliable indication of the relative trends in city fire losses in the United States and Canada. However, differences in methods of determining fire losses, of differentiating between alarms and building fires, and physical differences between cities may make any comparisons between cities of limited value.

Fire losses reflect the composite results of many different factors in addition to fire department efficiency. Some cities have high losses due primarily to unfavorable structural conditions and unusual hazards, despite efficient fire departments.

1946 Fire Losses, Cities of 20,000 Population and Over.

City	Population	Total Loss 1946	No. Alarms 1946	No. Bldg. Fires 1946	Bldg. Fires Per 1000 Population	5-Year Av. Loss Per Person	No. Malicious False Alarms 1946	Per Cent of False Alarms 1946
ALABAMA								
Anniston	25,523	....	....	....	....	....	....	....
Bessemer	22,826	....	....	....	....	....	....	....
Birmingham	267,583	$550,000a	3,510	1,084	4.1	2.42	306	8.7
Gadsden	36,975	432,644	459	188	5.1	3.30	8	1.7
Mobile	106,727	197,615	1,352	749	7.2	1.80	107	7.9
Montgomery	78,084	240,150	650	374	4.8	1.89	49	7.5
Tuscaloosa	27,493	90,185	253	108	3.9	2.52	15	6.0
ARIZONA								
Phœnix	65,414	101,700	896	319	4.9	2.06	101	11.3
Tucson	36,818	489,576	633	98	2.7	5.13	216	34.2
ARKANSAS								
Fort Smith	36,584	321,018	845	177	4.8	5.45	35	4.1
Hot Springs	21,370	100,156	340	160	7.5	2.65	8	2.4
Little Rock	88,039	167,960	2,043	526	6.0	3.21	79	3.9
North Little Rock	21,137	107,960	776	148	7.0	5.50	22	2.8
Pine Bluff	21,290	68,671	591	188	8.4	4.27	7	1.2
CALIFORNIA								
Alameda	89,906	60,805	671	180	2.0	0.56	61	9.1
Alhambra	44,013	34,993	390	62	1.5	0.33 (4)	96	25.0
Bakersfield	32,807	189,087	468	117	3.6	5.52	9	1.9
Belvedere Twp.	37,192	197,341c	720	....	....	2.71	27	3.8
Berkeley	100,024	259,140	1,700	466	4.5	1.58	86	5.1
Beverly Hills	28,217	366,130	444	95	3.4	3.79	27	6.1
Burbank	53,899	118,100	592	197	3.7	1.74	10	1.7
Compton	23,460	19,401	352	84	3.6	0.83 (1)	8	2.3
Coronado	25,382	23,223	129	25	1.0	3.92	20	15.5
Fresno	63,672	290,000	540	213	3.3	3.35	73	13.5
Glendale	96,495	358,662	822	287	3.0	1.99	80	9.7
Huntington Park	28,648	85,928	204	72	2.5	2.74	15	7.4
Inglewood	37,912	378,855	329	92	2.4	4.96	11	3.3
Long Beach	241,109	359,246	2,151	491	2.0	1.06	61	2.8
Los Angeles	1,805,687	3,544,990	22,773	6,979	3.9	1.71	2,093	9.2
Oakland	400,935	1,576,948	4,649	1,423	3.5	3.60	666	14.4
Pasadena	98,279	93,835	1,050	296	3.0	1.15	121	11.5
Pomona	23,539	21,781	304	98	4.1	3.77	5	1.6
Richmond	93,738	80,612	828	205	2.2	1.62	64	7.7
Riverside	43,939	179,387	465	124	2.8	1.59	34	7.3
Sacramento	119,984	251,700	1,535	450	3.8	2.69	167	10.9
San Bernardino	56,193	234,450a	703	205	3.6	2.04	19	2.7
San Diego	362,658	330,000	3,097	876	2.4	0.99	142	4.6
San Francisco	827,400	....	12,925	4,088	4.9	....	2,206	17.1
San Jose	68,457	214,096	763	354	5.2	2.10	70	9.2
San Leandro	22,903	24,855	229	71	3.1	0.77	....	....
San Mateo	26,804	26,426	466	39	1.5	1.30	19	4.1
Santa Ana	38,015	152,315	385	124	3.3	1.58	12	3.1
Santa Barbara	38,338	48,985	530	154	4.0	1.49	48	9.1
Santa Monica	67,473	134,069	921	215	3.1	1.52	68	7.4
South Gate	46,000	158,237	376	73	1.6	1.95	7	1.9
Stockton	58,865	468,327	1,333	321	5.5	4.54	42	3.2
Vallejo	42,941	....	....	....	....	....	....	....
COLORADO								
Colorado Springs	36,789	275,763	542	230	6.3	2.19	28	5.2
Denver	322,412	634,188	3,741	1,573	4.9	1.82	354	9.5
Pueblo	52,162	55,524	2,000	372	7.2	1.21	41	2.1

(a) Estimated. (c) From July 1, 1945 to June 30, 1946. (1) One year only.
(4) Four-year average.

City	Population	Total Loss 1946	No. Alarms 1946	No. Bldg. Fires 1946	Bldg. Fires Per 1000 Population	5-Year Av. Loss Per Person	No. Malicious False Alarms 1946	Per Cent of False Alarms 1946
CONNECTICUT								
Bridgeport	147,121	477,980	1,675	587	4.0	3.22	49	2.9
Bristol	30,167	52,750	488	106	3.5	4.96	21	4.3
Danbury	22,339	33,224	288	86	3.9	1.54	7	2.5
Greenwich	35,509	231,009	708	163	4.6	3.61	7	1.0
Hartford	166,267	236,126	1,974	525	3.1	1.46	121	6.1
Meriden	39,494	83,100	520	....	....	2.02	17	4.3
Middletown	26,495	47,833	206	84	3.2	0.88	3	1.5
New Britain	68,685	67,433	810	....	....	1.99	39	4.8
New Haven	160,605	1,076,007	2,454	892	5.6	4.30	204	8.3
New London	30,456	78,340	791	177	5.8	2.16	34	4.3
Norwalk	39,849	41,685	640	204	5.1	1.68	14	2.2
Norwich	23,652	42,290	344	154	6.5	1.46	3	0.9
Stamford	47,938	222,399	862	107	2.2	3.75	61	7.1
Stratford	22,580	73,900	385	69	3.1	3.04	3	0.8
Torrington	26,988	35,209d	281	116	4.3	1.02	....	....
Waterbury	99,314	167,505	1,738	346	3.5	2.64	61	3.5
West Hartford	33,776	27,062	442	146	4.3	1.40	6	1.4
West Haven Twp.	30,021	139,783d	555	37	1.2	3.76	12	....
DELAWARE								
Wilmington	111,432	178,909	1,269	1,114	10.0	1.62	48	3.8
DISTRICT OF COLUMBIA								
Washington	833,720	1,983,470	9,117	2,967	3.6	1.44	1,533	16.8
FLORIDA								
Daytona Beach	22,584	261,066	311	139	6.1	4.80	11	3.5
Jacksonville	173,065	2,269,923	2,315	750	4.3	4.65	148	6.4
Lakeland	22,068	20,190	310	....	....	0.73	26	8.4
Miami	172,172	465,594	3,982	....	....	2.56	1,355	34.0
Miami Beach	28,012	37,436	423	151	5.4	0.59	12	2.8
Orlando	36,736	24,550	544	45	1.2	1.32	63	11.6
Pensacola	37,449	94,400	594	227	6.1	3.87	67	11.3
St. Petersburg	60,812	119,569	1,125	210	3.5	2.02	23	2.0
Tampa	108,391	325,000b	1,325	342	3.2	2.66	185	14.0
West Palm Beach	33,693	36,988	417	119	3.5	1.59	7	1.7
GEORGIA								
Athens	20,650	22,249	348	144	7.2	1.33	16	4.6
Atlanta	302,288	1,022,981	5,469	2,465	8.2	1.71	346	6.3
Augusta	65,919	151,749	916	462	7.0	2.60	57	6.2
Columbus	53,280	61,215	599	278	5.2	1.32	40	6.7
La Grange	21,983	94,474	343	....	....	3.51	3	0.9
Macon	57,865	439,262	623	334	5.8	4.17	52	8.3
Rome	26,282	26,663	548	272	10.3	1.62	27	4.9
Savannah	95,996	222,328	1,177	603	6.3	1.56	111	9.4
IDAHO								
Boise	26,130	150,823	406	139	5.3	3.77	8	2.0
ILLINOIS								
Alton	31,255	1,039,059	430	225	7.2	7.77	3	0.7
Aurora	47,170	80,370	717	220	4.2	1.55	10	1.4
Belleville	28,405	32,960	399	133	4.7	1.67	3	0.8
Berwyn	48,451	39,435	286	74	1.5	0.51	4	1.4
Bloomington	32,868	103,747b	356	132	4.0	2.66	4	1.1
Champaign	23,302	21,995	263	199	8.5	1.49	4	1.5
Chicago	3,396,808	8,000,000a	42,893	12,230	3.6	1.87	3,682	8.6
Chicago Heights	22,461	53,138	198	112	5.0	3.44	15	7.6
Cicero	64,712	903,585	831	207	3.2	3.64	114	13.7
Danville	36,919	57,115	519	184	5.0	4.51	8	1.5
Decatur	59,305	34,932	703	312	5.3	1.68	16	2.3

(a) Estimated. (b) Subject to change. (d) From May 1, 1945 to April 30, 1946.

City	Population	Total Loss 1946	No. Alarms 1946	No. Bldg. Fires 1946	Bldg. Fires Per 1000 Population	5-Year Av. Loss Per Person	No. Malicious False Alarms 1946	Per Cent of False Alarms 1946
East St. Louis	75,609	408,032	1,175	371	4.9	2.24	103	0.9
Elgin	38,333	113,572	447	131	3.4	1.95	2	0.4
Evanston	65,389	92,897	1,063	229	3.5	0.91	74	6.9
Freeport	22,366	4,986	232	60	2.7	2.97	16	6.9
Galesburg	28,876	126,610	295	225	7.8	6.77	4	1.4
Granite City	22,974	30,600	254	162	7.1	2.65	....	....
Joliet	42,365	68,367	639	221	5.2	3.78	73	11.4
Kankakee	22,241	322,897	330	100	4.5	4.03	8	2.4
Maywood	26,648	11,766	275	107	4.0	1.00	16	5.8
Moline	34,608	28,845	304	84	2.4	1.43	27	8.9
Oak Park	66,015	64,443	549	242	3.7	0.52	9	1.6
Peoria	105,087	522,181	1,247	685	6.5	3.34	91	7.3
Quincy	40,469	153,742	602	408	10.1	1.57	16	2.7
Rockford	84,637	153,907	1,448	472	5.6	1.93	84	5.8
Rock Island	42,775	39,422	493	247	5.8	2.95	31	6.3
Springfield	75,503	410,849a	925	467	6.2	3.51	17	1.8
Waukegan	34,241	48,959	670	184	5.3	3.54	23	3.4
INDIANA								
Anderson	41,572	97,142	849	196	4.7	2.62	87	10.2
Bloomington	20,870	30,530	381	241	11.6	1.42	20	5.2
East Chicago	54,637	79,070	742	204	3.7	3.96	99	13.3
Elkhart	33,434	360,055	854	336	10.1	4.32	13	1.5
Evansville	97,062	....	....	....	....	....	....	....
Fort Wayne	118,410	48,712	2,051	591	5.0	0.85	155	7.6
Gary	111,719	....	....	....	....	....	....	....
Hammond	70,184	336,919	780	257	3.7	4.82	81	10.4
Indianapolis	386,972	859,566	4,691	2,181	5.6	2.23	426	9.1
Kokomo	33,795	82,356	504	376	11.2	2.24	36	7.1
Lafayette	28,798	140,460	402	....	....	3.42	31	7.7
Logansport	20,177	2,390	505	416	20.6	0.89	59	11.7
Marion	26,767	155,106	507	294	11.0	6.87	27	5.3
Michigan City	26,476	25,848	460	187	7.1	1.96	10	2.2
Mishawaka	28,298	24,610	513	122	4.3	1.00	70	13.6
Muncie	49,720	419,057	800	336	6.8	5.00	36	4.5
New Albany	25,414	142,755	438	240	9.4	2.40	25	5.7
Richmond	35,147	24,244	653	273	7.8	2.54	16	2.4
South Bend	101,268	210,696a	1,919	580	5.7	2.97	222	11.6
Terre Haute	62,693	76,068	936	152	2.4	1.75	82	8.8
IOWA								
Burlington	25,832	123,102	533	129	5.0	3.99	39	7.3
Cedar Rapids	62,120	70,885	643	336	5.4	2.21	36	5.6
Clinton	26,270	82,993	410	235	8.9	1.45	6	1.5
Council Bluffs	41,439	35,422	562	265	6.4	1.28	63	11.2
Davenport	66,039	136,930	751	157	2.4	1.24	102	13.6
Des Moines	159,819	447,255	2,076	735	4.6	2.99	104	5.0
Dubuque	43,892	217,444	844	372	8.5	3.94	42	5.0
Fort Dodge	22,904	23,389	294	80	3.5	1.59	21	7.1
Mason City	27,080	56,771	406	112	4.1	1.33	....	....
Ottumwa	31,570	54,670	436	217	6.9	2.26	20	4.6
Sioux City	82,364	316,235a	901	439	5.3	2.25	81	9.0
Waterloo	51,734	316,601	617	298	5.8	2.90	99	16.1
KANSAS								
Hutchinson	30,013	189,418	615	201	6.7	2.17	16	2.6
Kansas City	121,458	132,340	1,922	716	5.9	1.19	101	5.3
Salina	21,073	79,325	463	....	....	5.00	....	....
Topeka	67,833	222,621	1,030	312	4.6	1.52	99	9.6
Wichita	114,966	201,632	2,091	569	5.0	1.69	45	2.2
KENTUCKY								
Ashland	29,537	53,569	321	135	4.6	1.27	6	1.9

(a) Estimated.

City	Population	Total Loss 1946	No. Alarms 1946	No. Bldg. Fires 1946	Bldg. Fires Per 1000 Population	5-Year Av. Loss Per Person	No. Malicious False Alarms 1946	Per Cent of False Alarms 1946
Covington	62,018	140,314	609	419	6.8	1.72	40	6.6
Lexington	49,304	611,483	732	434	8.8	5.37	40	5.5
Louisville	319,077	372,188	3,591	1,798	5.6	1.38	255	7.1
Newport	30,631	18,294	288	220	7.2	1.01	15	5.2
Owensboro	30,245	59,498	651	213	7.0	1.46	38	5.8
Paducah	33,765	68,242	922	327	9.7	1.77	20	2.2
LOUISIANA								
Alexandria	27,066	30,070	334	75	2.8	1.90	40	12.0
Baton Rouge	34,719	74,026	525	52	1.5	1.46	68	13.0
Lake Charles	21,207	21,000	232	72	3.4	0.99 (1)	31	13.4
Monroe	28,309	82,387	640	161	5.7	3.10	34	5.3
New Orleans	494,537	875,052	3,131	1,487	3.0	1.53	241	7.7
Shreveport	98,167	292,031	1,094	318	3.2	3.31	53	4.8
MAINE								
Bangor	29,822	145,762	708	527	17.2	4.15	57	8.1
Lewiston	38,598	110,904	873	446	11.6	3.04	8	0.9
Portland	73,643	128,145	1,726	305	4.1	2.32	116	6.7
MARYLAND								
Baltimore	859,100	2,705,504	11,740	5,750	6.7	3.12	696	5.9
Cumberland	39,483	48,175	430	162	4.1	2.70	72	16.7
Hagerstown	32,491	....	....	....	....	....	....	....
MASSACHUSETTS								
Arlington	40,013	104,729	962	....	....	1.43	41	4.3
Attleboro	22,071	54,830	608	69	3.1	5.04	12	2.0
Belmont	23,867	15,310	651	148	5.5	0.89	25	3.8
Beverly	25,537	65,046	1,218	185	7.3	3.15	25	2.1
Boston	770,816	....	17,075	4,430	5.7	....	2,596	15.2
Brockton	62,343	184,207	2,551	512	8.2	3.00	....	....
Brookline	56,940	340,566	1,176	....	....	2.66	....	....
Cambridge	110,879	391,563	2,674	951	8.6	2.99	347	13.0
Chelsea	41,259	149,468	1,380	224	5.4	3.96	154	11.2
Chicopee	41,664	136,140	955	189	4.5	2.31	39	4.1
Everett	46,784	98,841	1,041	158	3.4	2.70	137	13.7
Fall River	115,428	840,209	1,380	302	2.6	2.57	112	8.1
Fitchburg	41,824	185,022	936	302	7.2	2.94	21	2.2
Framingham	23,214	424,480	812	76	3.3	7.65	30	3.7
Gardner	20,206	216,254	385	190	9.4	4.57	4	1.0
Gloucester	24,046	230,229	877	118	4.9	6.57	12	1.4
Haverhill	46,752	153,634	1,438	233	5.0	4.19	242	16.8
Holyoke	53,750	166,161	1,380	968	18.0	4.57	92	6.7
Lawrence	84,323	154,433	1,715	317	3.8	1.60	82	4.8
Leominster	22,226	114,865	661	....	....	2.96	27	4.1
Lowell	101,389	253,825	2,011	345	3.4	2.29	64	3.2
Lynn	98,123	423,482	2,980	619	6.3	3.25	314	10.5
Malden	58,010	162,494a	1,493	195	3.4	2.80	24	1.6
Medford	63,083	152,524	1,804	189	3.0	2.55	69	3.8
Melrose	25,333	60,390	682	59	2.3	1.66	6	0.9
Methuen	21,880	79,633	729	75	3.4	1.98	12	1.6
New Bedford	110,341	197,754	1,305	500	4.5	2.06	91	7.0
Newton	69,873	90,921	1,863	103	1.5	1.30	100	4.9
North Adams	22,213	123,596	359	199	9.0	2.09	2	0.6
Northampton	24,794	70,926	451	178	7.2	3.87	16	3.5
Peabody	21,711	143,579	857	141	6.5	4.18	41	4.8
Pittsfield	49,684	97,227a	818	181	3.6	2.29	30	3.7
Quincy	75,810	213,459	2,750	550	7.3	3.38	186	6.8
Revere	34,405	176,952	1,414	81	2.4	2.68	201	14.2
Salem	41,213	68,450	1,287	244	5.9	2.91	43	3.3
Somerville	102,177	257,030	2,128	276	2.7	2.09	286	13.4
Springfield	149,554	376,910a	3,093	547	3.7	4.07	323	10.5

(a) Estimated. (1) One year only.

City	Population	Total Loss 1946	No. Alarms 1946	No. Bldg. Fires 1946	Bldg. Fires Per 1000 Population	5-Year Av. Loss Per Person	No. Malicious False Alarms 1946	Per Cent of False Alarms 1946
Taunton	37,395	84,955	1,212	275	7.4	3.54	148	12.2
Waltham	40,020	132,388	1,235	175	4.4	3.10	87	7.0
Watertown	35,427	59,628	603	78	2.2	1.98	41	6.8
Weymouth	23,868	....	854	184	7.7	....	22	2.6
Worcester	193,694	435,000a	5,330	1,410	7.3	2.62	429	8.0
MICHIGAN								
Ann Arbor	29,815	101,925	432	111	3.7	3.32	11	2.5
Battle Creek	43,453	157,084	971	485	11.2	3.64	74	7.6
Bay City	47,956	124,592	754	315	6.6	3.12	42	5.6
Dearborn	72,985	114,959	888	287	3.9	6.23	165	18.6
Detroit	1,654,972	5,310,991	17,843	6,958	4.2	2.74	2,753	15.4
Ferndale	22,523	27,401	354	143	6.4	1.91	24	6.8
Flint	151,543	274,323	1,967	740	4.9	1.87	465	23.6
Grand Rapids	164,292	517,440	1,732	404	2.6	2.93	134	7.7
Hamtramck	52,470	350,747	540	350	6.7	3.22	130	24.1
Highland Park	50,810	274,785	659	262	5.2	2.81	73	11.1
Jackson	49,656	237,156	892	483	9.7	3.12	44	4.9
Kalamazoo	54,097	194,636	976	339	6.3	3.57	60	6.2
Lansing	78,753	115,414	1,722	455	5.8	2.99	99	5.8
Muskegon	50,215	1,071,464	577	108	2.2	8.10	51	8.8
Pontiac	65,945	197,424	796	348	5.3	4.28	83	10.4
Port Huron	32,759	352,443	738	272	8.3	5.32	65	8.8
Royal Oak	25,087	130,000a	483	177	7.1	2.53	37	7.7
Saginaw	82,794	164,615	1,276	351	4.2	2.62	45	3.5
Wyandotte	30,618	80,899	541	392	12.8	4.96	99	18.3
MINNESOTA								
Duluth	101,065	189,599b	1,439	385	3.7	2.44	115	8.0
Minneapolis	492,370	6,458,379	4,740	1,008	2.0	4.98	250	5.3
Rochester	26,312	56,000a	390	139	5.3	0.93	85	21.8
St. Cloud	24,173	101,596	317	160	6.7	2.46	15	4.7
St. Paul	287,736	801,737	3,815	989	3.4	2.38	250	6.6
Winona	22,490	133,523	359	206	9.2	4.67	28	7.8
MISSISSIPPI								
Greenville	20,892	39,669	305	....	....	1.80	5	1.6
Hattiesburg	21,026	25,440	518	515	10.2	2.17	15	2.9
Jackson	62,107	68,490	860	285	4.6	2.37	51	5.9
Laurel	20,598	168,915	208	144	7.0	3.35	8	3.8
Meridian	35,481	46,419	612	233	6.6	2.73	28	4.6
Vicksburg	24,460	10,850	401	38	1.6	0.79	21	5.2
MISSOURI								
Hannibal	20,865	39,973	254	128	6.1	1.73	5	2.0
Jefferson City	24,268	6,506	292	....	....	0.57	4	1.4
Joplin	37,144	57,627	1,258	362	9.8	1.47	16	1.3
Kansas City	399,178	1,105,041	5,939	....	....	2.73	578	9.7
St. Joseph	75,711	100,506	1,332	283	3.7	1.42	36	2.7
St. Louis	822,630	1,946,825a	9,272	3,540	4.3	2.16	1,108	12.7
Sedalia	20,428	90,416	269	162	7.9	2.48	2	0.7
Springfield	61,238	319,134	1,460	580	9.5	3.86	102	7.0
University City	33,023	55,360	709	88	2.7	0.76	3	0.4
MONTANA								
Billings	23,024	76,299	233	116	5.0	6.30	15	6.4
Butte	37,081	340,922	384	234	6.3	3.00	102	20.6
Great Falls	29,928	25,038	409	106	3.5	2.78	42	10.3
NEBRASKA								
Lincoln	81,984	60,000a	1,068	477	5.8	1.61	11	1.0
Omaha	223,844	800,000a	2,866	1,171	5.2	2.34	124	4.3

(a) Estimated. (b) Subject to change.

City	Population	Total Loss 1946	No. Alarms 1946	No. Bldg. Fires 1946	Bldg. Fires Per 1000 Population	5-Year Av. Loss Per Person	No. Malicious False Alarms 1946	Per Cent of False Alarms 1946
NEVADA								
Reno	21,317	163,321	870	119	5.6	4.78	22	2.5
NEW HAMPSHIRE								
Concord	27,171	70,771	606	236	8.7	2.78	12	2.0
Manchester	77,685	....	1,428	577	7.4	....	18	1.3
Nashua	32,927	69,638	627	289	8.8	4.60	12	1.9
NEW JERSEY								
Atlantic City	64,094	612,474	858	428	6.7	8.78	130	15.2
Bayonne	79,198	73,476	923	243	3.1	1.02	129	14.0
Belleville	28,167	65,749	434	76	2.7	1.69	18	4.1
Bloomfield	41,623	121,790	737	188	4.5	1.12	31	4.2
Camden	117,536	165,996	1,583	420	3.6	1.90	135	8.5
Clifton	48,827	66,831	737	48	1.0	5.25	30	4.1
East Orange	68,945	121,459	696	239	3.5	1.26	63	9.1
Elizabeth	109,912	223,147	1,067	354	3.2	1.42	83	7.8
Garfield	28,044	18,440	129	52	1.9	0.51	6	4.7
Hackensack	26,279	29,212	598	117	4.5	2.11	16	2.7
Hoboken	50,115	134,428	608	391	7.8	2.93	88	14.5
Irvington	55,328	209,752	532	....	....	1.67	48	9.0
Jersey City	301,173	303,910	3,054	....	....	0.86	406	13.3
Kearny	39,467	53,701	519	126	3.2	31.04	27	5.2
Linden	24,115	46,138	606	291	12.1	1.31	30	4.9
Maplewood	23,139	64,686	283	160	6.9	1.02	24	8.5
Montclair	39,807	56,308	585	102	2.6	1.40	40	6.8
Newark	429,760	1,690,479	4,982	1,966	4.3	3.21	545	10.9
New Brunswick	33,180	118,779	582	183	5.5	3.41	56	9.6
North Bergen Twp.	39,714	23,070	777	110	2.8	0.50	9	1.2
Nutley	21,954	59,889	601	78	3.5	1.85	20	3.3
Orange	35,717	101,066	368	102	2.9	2.40	38	10.3
Passaic	61,394	457,515	771	272	4.4	5.83	61	7.9
Paterson	139,656	....	....	....	....	....	....	....
Perth Amboy	41,242	86,440	183	89	2.2	3.58	15	8.2
Plainfield	37,469	48,766	618	146	4.0	3.49	31	5.0
Teaneck Twp.	25,275	55,500	746	155	6.1	1.09	11	1.5
Trenton	124,697	283,497	1,149	514	4.1	1.60	104	9.1
Union City	56,173	62,011	595	210	3.7	2.09	46	7.7
Union Twp.	24,730	3,335	384	54	2.2	1.52	3	.08
West New York	39,439	38,349	504	82	2.1	1.15	33	6.5
West Orange	25,662	39,252	371	135	5.3	0.76	17	4.6
Woodridge	27,191	....	....	....	....	....	....	....
NEW MEXICO								
Albuquerque	35,449	....	....	....	....	....	....	....
Santa Fe	20,325	....	....	....	....	....	....	....
NEW YORK								
Albany	130,577	196,221	2,290	1,087	8.3	1.76	472	20.6
Amsterdam	33,329	74,174	394	83	2.5	2.82	16	4.1
Auburn	35,753	191,797	445	170	4.8	1.92	21	4.7
Binghamton	78,309	115,353	840	266	3.4	3.13	22	2.6
Buffalo	575,901	1,258,633a	5,539	1,496	2.6	1.90	377	6.8
Cohoes	21,955	35,000	290	99	4.5	1.59 (1)	8	2.8
Elmira	45,106	144,287	499	261	5.8	1.69	22	4.4
Freeport	20,400	28,930	317	85	4.2	7.67 (2)	23	7.3
Gloversville	23,329	45,000a	318	90	3.9	2.05	7	2.2
Hempstead	20,856	171,501	420	53	2.5	3.77	20	4.8
Jamestown	42,638	101,868	674	164	3.8	2.60	16	2.4
Kingston	28,589	64,965	560	171	6.0	1.43	13	2.3
Lackawanna	24,058	14,740	327	53	2.2	1.60	84	25.7
Lockport	24,379	175,845	327	....	....	3.70 (4)	11	3.4
Middletown	21,908	30,735	191	....	....	1.40 (1)	7	3.7

(a) Estimated. (1) One year only. (2) Two-year average. (4) Four-year average.

City	Population	Total Loss 1946	No. Alarms 1946	No. Bldg. Fires 1946	Bldg. Fires Per 1000 Population	5-Year Av. Loss Per Person	No. Malicious False Alarms 1946	Per Cent of False Alarms 1946
Mount Vernon	67,362	74,667	686	198	2.9	1.19	56	8.2
New Rochelle	58,408	116,117	687	240	3.1	1.51	21	3.1
New York	7,454,995	16,991,465	62,108	22,133	2.9	1.63	13,255	21.3
Newburgh	31,883	101,901	360	161	5.1	3.10	27	7.5
Niagara Falls	78,029	137,050	1,005	310	4.0	1.24	234	23.4
North Tonawanda	20,254	41,894	276	104	5.1	3.47	21	7.6
Olean	21,506	19,500	351	96	4.5	1.32	15	4.3
Oswego	22,062	42,885	369	123	5.6	6.10	50	13.6
Port Chester	23,073	65,000	239	....	....	3.16 (2)	5	2.1
Poughkeepsie	40,478	82,916	487	....	....	2.58	48	9.9
Rochester	324,975	673,128	3,384	922	2.8	1.57	216	6.4
Rome	34,214	84,006	539	159	4.6	2.79	23	4.3
Schenectady	87,549	149,088	1,169	284	3.2	2.05	92	7.9
Syracuse	205,967	479,822	2,110	745	3.6	2.90	254	12.0
Troy	70,304	223,900	1,250	391	5.6	2.72	40	3.2
Utica	100,518	203,877	930	428	4.3	2.02	29	3.1
Watertown	33,385	136,437	491	215	6.5	2.94	26	5.3
White Plains	40,327	57,926	604	158	3.9	1.08	30	5.0
Yonkers	142,598	197,042	2,299	817	5.7	1.51	147	6.4
NORTH CAROLINA								
Asheville	51,310	50,415	832	253	4.9	2.52	47	5.7
Burlington	21,830	50,090	....	21	1.0	2.30 (1)	....	....
Charlotte	100,899	387,484	1,818	792	7.9	3.12	145	8.0
Durham	60,195	94,875	811	344	5.7	2.17	43	5.3
Gastonia	21,313	37,040	264	105	4.9	2.23	12	4.5
Greensboro	59,319	129,328	1,008	254	4.3	2.28	168	16.7
High Point	38,495	246,428	578	226	5.9	6.06	46	8.0
Raleigh	46,897	102,691	992	732	15.6	2.13	137	13.8
Rocky Mount	25,568	25,590	318	138	5.4	0.95	8	2.5
Wilmington	47,483	111,577	499	360	7.6	1.74	52	10.4
Winston-Salem	79,815	158,316	935	125	1.6	3.02	146	14.6
NORTH DAKOTA								
Fargo	32,580	38,973	272	191	5.9	0.83	9	3.3
Grand Forks	20,228	80,538	265	95	4.7	7.80	23	8.7
OHIO								
Akron	244,791	494,258	2,684	785	3.2	2.21	294	11.0
Alliance	22,405	31,350	164	106	4.7	5.79	20	12.2
Ashtabula	21,405	160,883	339	120	5.6	3.44	6	1.8
Barberton	24,028	93,837	312	134	5.6	1.87	88	28.2
Canton	108,401	292,467	788	291	2.7	3.02	90	11.4
Chillicothe	20,129	24,385	264	45	2.2	0.69	10	3.8
Cincinnati	455,610	828,878	5,359	1,898	4.2	2.07	437	8.2
Cleveland	878,336	3,277,821	9,370	2,890	3.3	4.82	937	10.0
Cleveland Heights	58,000	45,602	715	270	4.6	0.54	5	0.7
Columbus	306,087	434,905	7,538	1,984	6.5	1.67	207	2.7
Cuyahoga Falls	20,546	22,795	406	73	3.6	0.82	16	3.9
Dayton	210,718	463,742	2,797	834	4.0	2.51	469	16.8
East Cleveland	39,495	176,059	369	133	3.4	1.40	22	6.0
East Liverpool	23,555	64,378	415	181	7.7	1.33	22	5.3
Elyria	25,120	81,949	303	152	6.1	3.09	1	0.3
Findlay	20,228	529,012	293	75	3.7	7.17	7	2.4
Hamilton	50,592	62,642	844	516	10.2	1.99	63	7.5
Lakewood	69,160	50,744	375	99	1.4	0.99	74	19.7
Lancaster	21,940	19,092	264	107	4.9	1.42	25	9.5
Lima	44,711	227,315	796	205	4.5	4.36	27	3.4
Lorain	44,125	116,760	552	158	3.6	1.56	41	7.4
Mansfield	37,154	36,155	533	192	5.2	4.83	44	8.3
Marion	30,817	20,475	399	148	4.8	1.31	25	6.3
Massillon	26,644	60,620	349	107	4.0	4.75	16	4.6

(1) One year only. (2) Two-year average.

City	Population	Total Loss 1946	No. Alarms 1946	No. Bldg. Fires 1946	Bldg. Fires Per 1000 Population	5-Year Av. Loss Per Person	No. Malicious False Alarms 1946	Per Cent of False Alarms 1946
Middletown	31,220	128,360	421	187	6.0	2.58	42	10.0
Newark	31,487	160,992	434	213	6.8	2.47	7	1.6
Norwood	34,010	21,188	280	127	3.7	0.77	21	7.5
Portsmouth	40,466	332,223	454	248	6.1	2.92	64	14.1
Sandusky	24,874	31,842	696	164	6.6	3.04	2	0.3
Shaker Heights	23,393	22,732	364	117	5.0	1.30	11	3.0
Springfield	70,662	239,295	858	275	3.9	2.70	22	2.6
Steubenville	37,651	47,755	400	123	3.3	1.52	56	14.0
Toledo	282,349	477,915a	2,977	1,023	3.6	2.03	511	17.2
Warren	42,837	79,431	481	168	3.9	1.28	17	3.5
Youngstown	167,720	462,941	1,267	981	5.9	1.49	99	7.8
Zanesville	37,500	11,496	519	183	4.9	1.76	94	18.1
OKLAHOMA								
Enid	28,081	141,070	574	146	5.2	3.31	49	8.5
Muskogee	32,332	156,802	1,202	205	6.3	2.29	16	1.4
Oklahoma City	204,424	170,985	3,476	609	3.0	1.56	129	3.7
Shawnee	22,053	57,962	501	33	1.5	2.45	14	2.8
Tulsa	142,157	184,239	2,842	693	4.9	1.91	151	5.3
OREGON								
Eugene	20,838	241,586	664	415	19.9	5.62	3	0.5
Portland	363,141	1,169,810	4,928	3,290	9.1	4.21	351	7.1
Salem	30,908	750,382	415	....	....	9.67	2	0.5
PENNSYLVANIA								
Abington Twp.	20,857	....	....	....	....	....	....	....
Aliquippa	27,023	9,299	168	62	2.3	0.37	14	8.3
Allentown	96,904	192,521	313	263	2.7	0.76	33	10.5
Altoona	80,214	77,275	795	406	5.1	0.71	199	25.0
Bethlehem	58,490	23,728	231	94	1.6	1.27	4	1.7
Butler	24,477	87,590	228	102	4.2	1.53	8	3.5
Chester	59,285	....	....	....	....	....	....	....
Dunmore	23,086	52,000	136	24	1.0	0.95	11	8.1
Duquesne	20,693	25,275	182	....	....	1.21 (1)	47	25.8
Easton	33,589	56,580	186	118	3.5	3.00	9	4.8
Erie	116,955	178,370	1,256	446	3.8	2.52	86	6.8
Harrisburg	83,893	123,000a	543	325	3.9	2.25	26	4.8
Haverford Twp.	27,594	....	....	....	....	....	....	....
Hazelton	38,009	....	....	....	....	....	....	....
Johnstown	66,668	16,702	691	313	4.7	0.40	57	8.3
Kingston	20,679	44,635	129	46	2.2	1.47	6	4.6
Lancaster	61,345	1,392,525	344	275	4.5	5.30	69	20.1
Lebanon	27,206	12,789a	76	54	2.0	5.07	6	7.9
Lower Merion Twp.	39,566	149,169	649	166	4.2	3.52	2	0.3
McKeesport	55,355	31,628	509	242	4.4	3.14	48	9.4
Monessen	20,257	361,775	40	34	1.7	5.56	3	7.5
Nanticoke	24,387	16,000a	106	85	3.5	0.93 (4)	10	9.4
New Castle	47,638	....	....	....	....	....	....	....
New Kensington	24,055	16,546	116	42	1.7	1.25	27	23.3
Norristown	38,181	60,078	201	114	3.0	0.78	2	1.0
Oil City	20,379	199,522	231	53	2.6	2.76	16	6.9
Philadelphia	1,931,334	6,743,520	15,378	5,439	2.8	2.72	1,883	12.3
Pittsburgh	671,659	3,500,000a	6,208	2,352	3.5	2.23	1,056	17.5
Pottstown	20,194	24,811	116	28	1.4	2.88	4	3.5
Pottsville	24,530	25,117	130	71	2.9	1.18	2	1.5
Reading	110,568	142,177	526	120	1.1	1.38	24	4.6
Scranton	140,404	334,137	1,040	....	....	2.10	1.59	15.9
Sharon	25,622	110,756	194	25	1.0	2.46	3	1.5
Uniontown	21,819	15,925	230	142	6.5	2.80	6	2.6
Upper Darby Twp.	56,883	117,393	444	112	2.0	1.16	....	....
Washington	26,166	80,016	247	133	5.1	1.32	25	10.1
Wilkes-Barre	86,236	133,476	491	228	2.6	1.80	53	10.8

(a) Estimated. (1) One year only. (4) Four-year average.

City	Population	Total Loss 1946	No. Alarms 1946	No. Bldg. Fires 1946	Bldg. Fires Per 1000 Population	5-Year Av. Loss Per Person	No. Malicious False Alarms 1946	Per Cent of False Alarms 1946
Wilkinsburg	29,853	92,378	154	90	3.0	0.96	26	16.9
Williamsport	44,355	81,367	355	144	3.2	1.28	14	3.9
York	56,712	39,899b	282	148	2.6	1.50	40	14.2
RHODE ISLAND								
Central Falls	25,121	39,900	341	105	4.2	1.44	19	5.6
Cranston	47,173	99,757	1,210	138	2.9	1.45	68	5.6
East Providence	32,093	133,226	1,116	122	3.8	2.02	98	8.8
Newport	30,402	22,576	456	212	7.0	1.99	31	6.8
Pawtucket	75,449	136,886	1,690	397	5.3	2.55	216	12.8
Providence	253,214	541,536	4,833	854	3.4	1.95	670	13.9
Warwick Twp.	28,616	62,695	1,043	157	5.5	2.19 (1)	14	1.4
Woonsocket	49,204	82,727	788	160	3.3	3.54	24	3.0
SOUTH CAROLINA								
Charleston	81,347	161,955	922	457	5.6	2.33	195	21.2
Columbia	62,396	194,647	1,104	442	7.1	2.36	68	6.2
Greenville	34,734	1,379,315	607	298	8.6	10.05	16	2.6
Spartanburg	32,249	337,732	743	272	8.4	7.92	57	7.7
SOUTH DAKOTA								
Sioux Falls	40,832	37,738	395	202	4.9	0.93	12	3.0
TENNESSEE								
Chattanooga	128,163	289,245	1,847	548	4.3	2.28	167	9.0
Jackson	24,332	155,631	495	255	10.5	3.39	1	0.2
Johnson City	25,353	44,890	497	102	4.0	2.12	6	1.2
Knoxville	111,580	145,855	1,499	624	5.6	1.20	104	6.9
Memphis	292,942	1,019,564	4,083	1,166	4.0	2.69	106	2.6
Nashville	167,402	736,047	3,443	903	5.4	3.40	208	6.0
TEXAS								
Abilene	26,612	54,969	532	90	3.4	6.19	23	4.3
Amarillo	51,686	226,378	706	....	....	3.05	61	8.6
Austin	115,000	163,348	1,490	307	2.7	1.39	40	2.7
Beaumont	77,335	133,273	998	676	8.7	2.83	27	2.7
Brownsville	22,083	99,566	190	....	....	1.45	14	7.4
Corpus Christi	57,301	113,344	923	252	4.4	2.56	134	14.5
Dallas	294,734	2,568,867	5,578	2,121	7.2	5.66	287	5.1
El Paso	96,810	109,000	1,094	431	4.4	1.25	145	13.9
Fort Worth	177,662	763,754	3,800	1,172	6.6	3.97	307	8.1
Galveston	60,862	667,895	....	252	4.1	5.99	276	....
Houston	384,514	1,490,004a	5,315	1,871	4.9	3.42	663	12.5
Laredo	39,274	62,499	273	103	2.6	1.00	16	5.9
Lubbock	31,853	315,000a	472	....	....	4.12	8	1.7
Port Arthur	56,065	174,995	388	67	1.2	1.25	59	15.2
San Angelo	25,802	75,037	368	180	7.0	2.28	29	7.9
San Antonio	253,854	845,317	3,076	1,059	4.2	2.52	197	6.4
Tyler	28,279	81,192	579	102	3.6	3.31	10	1.7
Waco	55,982	111,618	837	344	6.1	3.17	49	5.8
Wichita Falls	45,112	212,000	1,097	122	2.7	8.50	87	7.9
UTAH								
Ogden	43,688	207,488	1,138	253	5.8	2.22	60	5.3
Salt Lake City	149,934	376,652	1,973	851	5.7	2.68	109	5.5
VERMONT								
Burlington	27,686	....	537	344	12.4	....	16	3.0
VIRGINIA								
Alexandria	49,584	262,150	620	196	3.9	2.76	14	2.6
Arlington County	57,040	68,250	1,255	392	0.7	1.20 (1)	17	1.4
Danville	32,749	493,078	....	386	11.8	4.87	173	....
Lynchburg	44,541	84,289	796	311	7.0	3.05	188	23.6

(a) Estimated. (b) Subject to change. (1) One year only.

City	Population	Total Loss 1946	No. Alarms 1946	No. Bldg. Fires 1946	Bldg. Fires Per 1000 Population	5-Year Av. Loss Per Person	No. Malicious False Alarms 1946	Per Cent of False Alarms 1946
Newport News	45,599	71,721	761	299	6.6	6.22	94	12.7
Norfolk	231,949	743,977	3,300	1,301	5.6	2.82	468	14.2
Petersburg	30,631	23,944	536	233	7.6	1.58	36	6.7
Portsmouth	81,951	461,375	758	270	3.3	2.75	83	11.0
Richmond	222,818	243,572	3,543	1,672	7.5	1.03	281	7.9
Roanoke	69,287	174,707	832	399	5.8	2.25	109	13.1
WASHINGTON								
Bellingham	29,314	32,528	722	268	9.1	3.23	77	10.7
Everett	30,224	55,863	728	476	15.7	2.76	12	1.6
Seattle	434,204	546,317	5,103	1,019	2.3	1.49	397	7.8
Spokane	122,001	531,054	2,200	775	6.4	3.04	123	5.6
Tacoma	129,302	371,510	2,260	1,267	9.8	3.12	186	8.2
Yakima	27,221	219,286	474	250	9.2	4.23	19	4.0
WEST VIRGINIA								
Bluefield	20,641	148,010	264	57	2.8	2.79	25	9.5
Charleston	67,914	1,124,952	783	607	8.9	4.90	102	13.1
Clarksburg	30,579	14,962	286	86	2.8	1.58	11	3.8
Fairmont	23,105	57,500	225	128	5.5	2.32	1	0.4
Huntington	78,836	389,794	1,106	294	3.7	4.45	138	12.5
Parkersburg	30,103	36,584	295	79	2.6	1.95	16	5.4
Wheeling	61,099	42,536	639	299	4.9	2.36	46	7.2
WISCONSIN								
Appleton	28,436	29,586	450	205	7.2	1.75	38	8.4
Beloit	25,365	38,216a	553	207	8.2	1.36	78	14.1
Eau Claire	30,745	247,560	600	263	8.1	2.94	54	9.0
Fond du Lac	27,209	40,603	399	241	8.9	4.61	23	5.8
Green Bay	46,235	70,629	612	240	5.2	2.54	23	3.8
Janesville	22,992	46,018	427	207	9.0	4.34	8	1.9
Kenosha	48,765	132,975	1,022	326	6.7	2.16	23	2.2
La Crosse	42,707	59,614	617	373	8.7	3.88	31	5.0
Madison	67,447	351,317a	943	386	5.7	1.83	43	4.6
Manitowoc	24,404	190,050	435	194	8.0	3.00	35	8.1
Milwaukee	587,472	2,239,591	7,172	3,460	5.9	2.10	279	3.9
Oshkosh	39,089	60,395	469	226	5.8	2.72	11	2.3
Racine	67,195	336,458	691	334	5.0	2.34	36	5.9
Sheboygan	40,638	50,977	361	181	4.5	1.04	26	7.2
Superior	35,136	247,447	683	266	7.6	9.90	58	8.5
Wausau	27,268	172,064	499	248	9.1	2.03	11	2.2
Wauwatosa	27,769	80,000	280	92	3.3	1.26	5	1.8
West Allis	36,364	33,819	509	91	2.5	1.18	22	4.3
WYOMING								
Cheyenne	22,408	44,054	531	406	18.1	3.11	42	7.9
HAWAII								
Honolulu	200,158	319,048a	1,340	382	1.9	1.39	252	18.8

1946 Fire Losses, Canadian Cities.

ALBERTA								
Calgary	97,241	406,805	858	136	1.4	2.17	171	19.9
Edmonton	120,000	725,007	1,078	411	3.4	3.16	124	11.5

(a) Estimated.

City	Population	Total Loss 1946	No. Alarms 1946	No. Bldg. Fires 1946	Bldg. Fires Per 1000 Population	5-Year Av. Loss Per Person	No. Malicious False Alarms 1946	Per Cent of False Alarms 1946
BRITISH COLUMBIA								
Burnaby	35,000	9,428	272	140	4.0	0.67 (2)	3	1.1
New Westminster	24,000	72,625	342	245	1.0	2.06	15	4.4
Saanich	25,000	16,483	250	114	4.6	1.36	10	4.0
Vancouver	360,000	731,222a	3,668	2,510	7.0	3.33	98	2.7
Victoria	53,000	61,792	766	340	6.4	1.19	95	12.6
MANITOBA								
Winnipeg	224,252	1,053,102	2,857	1,316	5.9	2.20	314	11.0
NEW BRUNSWICK								
Moncton	22,763	58,000	358	250	11.0	3.84	10	2.8
Saint John	51,741	146,465	1,125	955	18.5	4.42	75	6.7
NOVA SCOTIA								
Dartmouth	20,000	18,395	231	150	7.5	0.95	10	4.3
Glace Bay	25,147	82,000	175	95	3.8	1.63	....	....
Halifax	106,742	232,085	1,126	852	8.0	5.05	223	19.8
Sydney	35,000	106,550	188	68	1.9	2.38	275	14.6
ONTARIO								
Brantford	34,848	44,272	423	164	4.2	1.32	7	1.7
East York Twp.	43,399	66,645	292	233	5.4	0.63	9	3.1
Fort William	29,103	144,441	515	126	4.3	3.18	12	2.3
Guelph	23,275	398,524	316	170	7.3	6.71	....	....
Hamilton	175,364	1,600,000a	1,592	680	3.9	4.56	134	8.4
Kingston	33,296	545,580	567	191	5.7	5.47	47	8.3
Kitchener	36,797	36,000a	283	30	0.8	2.51	1	0.4
London	81,158	100,000a	850	285	3.5	1.07	12	1.4
North York Twp.	26,000	90,450	342	86	3.3	3.99	12	3.5
Oshawa	26,856	24,665	328	210	7.8	2.36	24	7.3
Ottawa	195,327	537,798	1,979	592	3.0	2.96	176	8.9
Peterboro	32,379	627,647	789	59	1.8	5.12	37	4.7
Port Arthur	25,100	21,547	529	250	10.0	6.34	4	0.8
St. Catharines	34,559	61,524	413	241	7.0	2.06	8	1.9
Sarnia	20,082	31,708	222	59	3.0	3.33	25	11.3
Sault Ste. Marie	28,813	27,425	308	55	1.9	1.45	23	7.5
Scarboro Twp.	24,142	56,261	310	68	2.8	1.83	22	7.1
Sudbury	35,812	183,704	461	339	9.5	2.73	17	3.7
Timmins	24,070	59,026	538	256	10.6	3.34	18	3.3
Toronto	745,626	3,000,000a	6,019	3,475	4.7	3.06	599	9.9
Windsor	108,567	....	....	....	....	....	....	....
York Twp.	80,348	70,120	566	308	3.8	0.72	22	3.9
QUEBEC								
Chicoutimi	20,103	44,575	....	....	....	2.24 (1)	....	....
Hull	36,900	32,400	900	321	8.7	2.50	25	2.8
Jonquire	21,500	479,500	....	....	....	11.35 (2)	....	....
Lachine	27,104	37,225a	149	107	4.0	1.72	28	18.8
Montreal	1,320,000	4,280,326	9,977	4,111	3.1	2.68	2,095	21.0
Outremont	31,400	55,251	244	26	0.8	2.65	29	11.9
Quebec	176,386	739,371a	3,381	2,357	13.4	4.33	497	14.7
Shawinigan Falls	25,000	193,019	337	285	11.4	3.12	12	3.6
Sherbrooke	38,942	69,180	864	593	15.3	1.76	38	4.4
Three Rivers	42,000	110,000	588	452	10.8	2.27	19	3.2
Verdun	75,000	102,750	721	315	4.2	1.15	134	18.6
Westmount	26,000	100,039	317	70	2.7	2.24	31	9.8
SASKATCHEWAN								
Moose Jaw	20,753	22,177	282	151	7.3	0.98	32	11.4
Regina	60,000	70,700a	715	399	6.6	1.84	83	11.6
Saskatoon	43,027	319,813	554	303	7.0	3.04	92	16.6

(a) Estimated. (1) One year only. (2) Two-year average.

VOLUME XXXX. INDEX.

This volume includes: No. 1, July 1946; No. 2, October 1946; No. 3, January 1947; No. 4, April 1947. Additional separate parts, not included in the Index, have been mailed as follows:
No. 1, Part 2. Proceedings of the Fiftieth Annual Meeting.
No. 2, Part 2. Membership Directory "Year Book."
No. 4, Part 2. Advance Reports to Fifty-first Annual Meeting.
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The continuous high ratio of immunity from fire and burglary losses enjoyed by ADT Subscribers for the past ten years is most significant.

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ADT

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Investigations of failures of watchmen to signal Central Stations on schedule 230,645

Total number of signals recorded . . . 356,272,168

Watchmen's patrol efficiency . . . 99 94/100ths %

Fire alarms from manual boxes 1432

Insurable values of properties protected $15,001,714,000

Ratio of fire losses to insurable values protected 5/100ths of 1%

Fire loss immunity in 1946 . . . 99 95/100ths %

Average fire loss immunity during the past ten years 99 97/100ths %

SPRINKLER SUPERVISORY AND WATERFLOW ALARM SERVICE

Supervisory alarms, indicating impairment of sprinkler systems. 149,592

Waterflow alarms, indicating fires or serious leaks 2621

Manual fire alarms 116

Insurable values of properties protected $7,192,794,000

Ratio of fire and water losses to insurable values protected . . . . . 2/100ths of 1%

Fire loss immunity in 1946 . . . . 99 98/100ths %

Average fire loss immunity during the past ten years 99 98/100ths %

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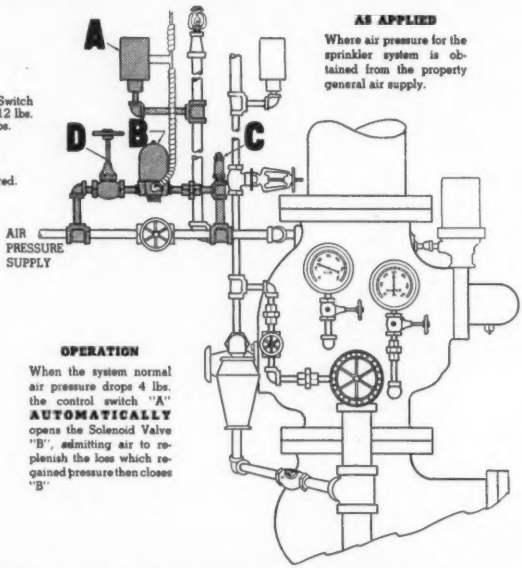

AS APPLIED

Where air pressure for the sprinkler system is obtained from the property general air supply.

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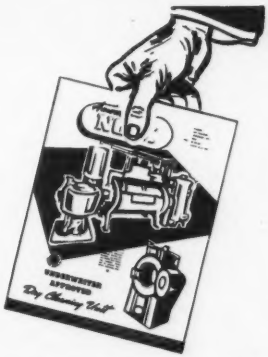

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★ NOEX is designed to give positive safety protection with all listed petroleum solvents having a flash point of 138.2°F., or over.

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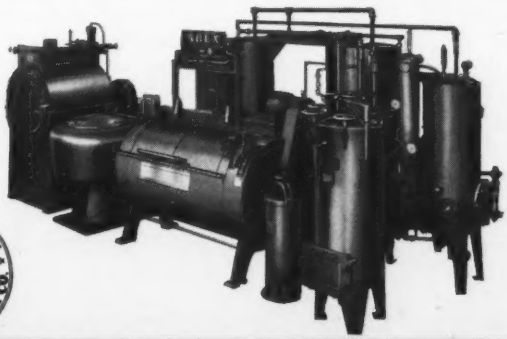

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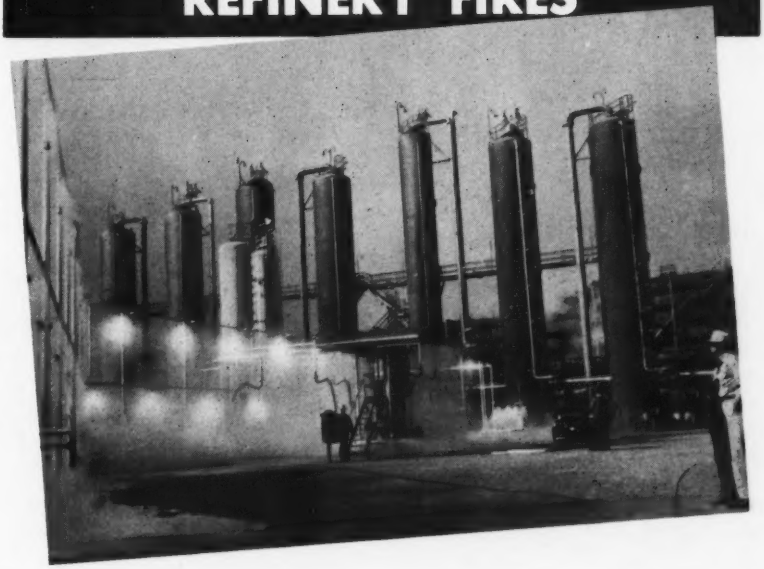

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The new 5-lb. GENERAL ◐-SnoFoe fits the standard 4-lb. wall bracket. Improved design of the shell makes it unusually light and easy to handle, with no sacrifice of structural strength.

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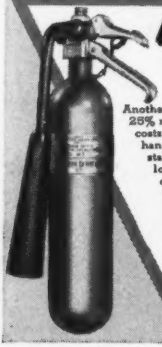


New 2½-lb. Size, Also!

Another new ◐-SnoFoe—2½-lb. size—gives 25% more fire protection than the 2-lb. size, yet costs the same. It is light, strong, and easy to handle, due to improved shell design—an outstanding value. See the yellow section of your local telephone directory for your nearest GENERAL dealer. Ask him to show you both these new ◐-SnoFoe extinguishers, or write for complete details.

Service For You . . .

Through GENERAL'S Distribution System

To assure you immediate service, GENERAL maintains a nation-wide network of 20 branch offices and warehouses. There is one near you. Call your local GENERAL representative for advice and counsel on all your fire protection needs, or write direct.

THE GENERAL DETROIT CORP.

Manufacturers of Fire Extinguishers
Motor Fire Apparatus and Allied Equipment

2270 E. JEFFERSON • DETROIT 7, MICHIGAN

NEW YORK • PHILADELPHIA • ATLANTA • CHICAGO • DALLAS

West Coast Subsidiary: The General Pacific Corp.
Los Angeles San Francisco Denver Seattle

Distributors in Principal Cities

RELIABLE

AUTOMATIC SPRINKLER DEVICES

PROTECTING LIFE AND PROPERTY FOR OVER 25 YEARS

Reliable Automatic Sprinkler Devices have an excellent field record . . . superb in design and construction . . . are universally approved by all Fire Insurance and Governmental Authorities . . . and effect maximum reductions in fire insurance premiums.

They comprise a complete line including Automatic and Open Sprinklers, Alarm Valves, Dry Pipe Valves, Accelerators, Circuit Closers, Water Motors and all other accessories required in Sprinkler Systems.

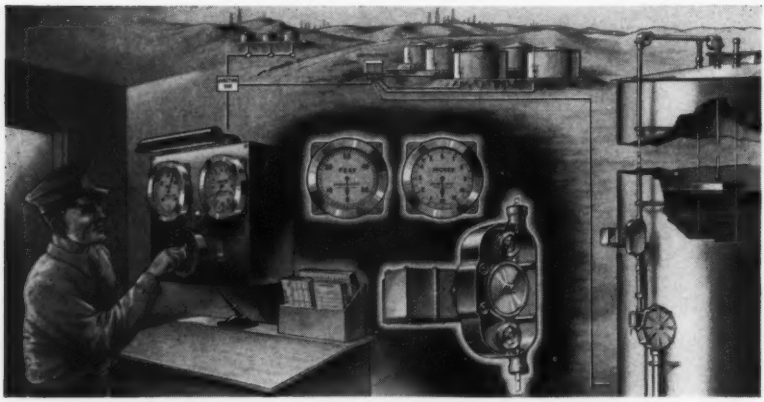
Reliable Systems are protecting thousands of properties throughout the United States, Canada and foreign countries.

FURTHER INFORMATION UPON REQUEST

Manufactured and Distributed by

The Reliable Automatic Sprinkler Co. Inc.

BRONX STREET MOUNT VERNON N. Y.



★THERE IS SAFETY
IN REMOTE GAUGING

Petroleum Tank Gauging by electrical remote control is the Shand & Jurs conception of maximum safety in taking inventory of storage tanks. Often the job has to be done at midnight on the last day of each month. Manual gauging involves climbing stairs with the aid of a flashlight, opening gauge hatches, suspending a bob on a steel tape and trying to record figures in the darkness with hands numb from the cold. Just one spark and anything can happen. Just one misstep and the gauger may fall in the darkness and break bones or lose his life. S. & J. believes that this important task of checking gallonage should be done electrically, quickly, accurately, under full illumination. We will gladly send you a bulletin which describes the operation of the system pictured above.

SHAND & JURS CO.
BERKELEY, CALIFORNIA
New York · Chicago · Houston · Los Angeles · Seattle

SHAND & JURS

Pyrene News

KEEP FIRES FROM MAKING THE FRONT PAGE

Just imagine, for a moment, this setting for a big news story: A storeroom full of flammable chemicals, ten-gallon containers stacked one above the other. A can on the bottom layer dented by the prongs of a lift truck, the liquid dripping, unseen, in a puddle between the rows of cans. A spark from a worker's heel, a carelessly dropped burning cigarette or a small arc from an exhaust fan . . . no one ever knows for sure how such fires start . . . but the puddle flares up, licking around the stacks of cans, and in five minutes the space might well become a roaring, flaming threat to the whole plant — the kind of fire that makes the front page. This one doesn't. There is the proper fire extinguisher in the right place; before the fire has a chance, Pyrene* Vaporizing Liquid completely smothers it.

Your home is not immune from fire; protect it with a handy, easy-to-operate 1 quart Pyrene Extinguisher.

For protection of flammable liquids the *Pyrene* Foam Type is also recommended.

The *Pyrene* 2 Quart or 1 Gallon Stored Pressure extinguisher envelops flammable liquid fires, prevents spreading and smothers them in seconds. On striking the fire, the liquid vaporizes into heavy, non-conducting mist which penetrates the smallest spaces; it may be used against electric fires and does not injure delicate equipment.

Pyrene FIRE EXTINGUISHERS

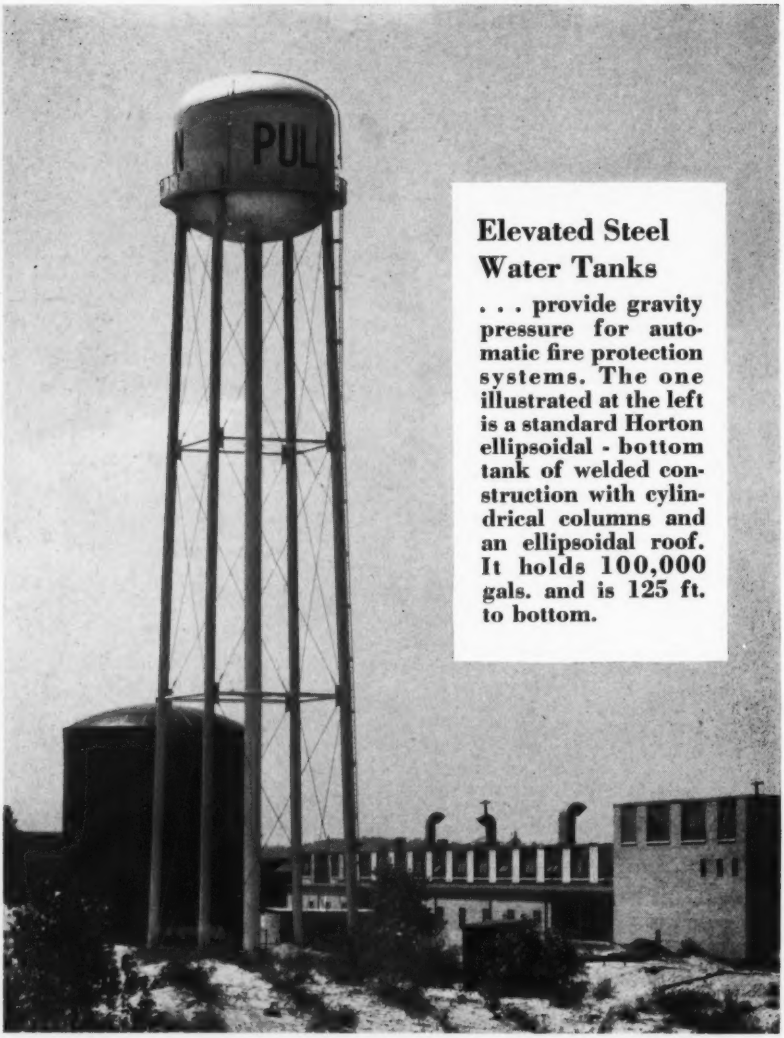
Let a Pyrene jobber or one of our engineers help you plan your complete fire protection; write for information today.

*T. M. Reg. U. S. Pat. Off.

Pyrene Manufacturing Company

NEWARK 8 • NEW JERSEY

Affiliated with C-O-Two Fire Equipment Company



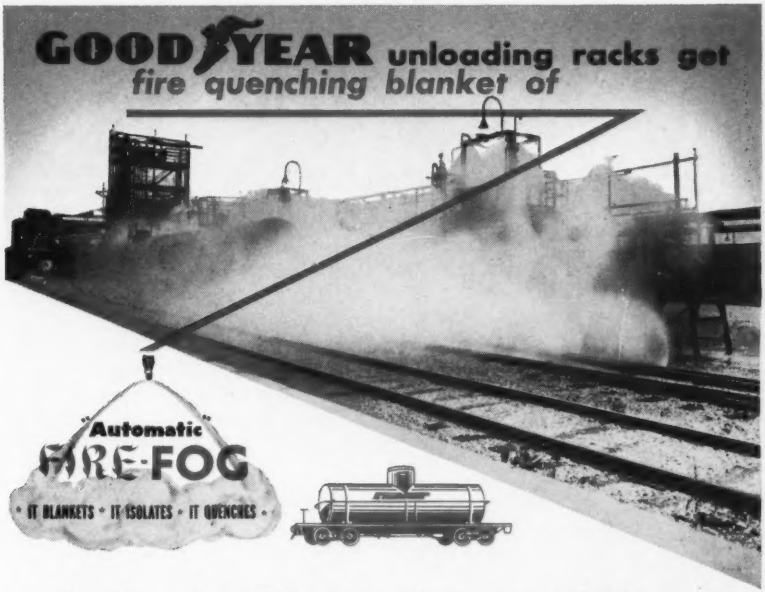
Elevated Steel Water Tanks

. . . provide gravity pressure for automatic fire protection systems. The one illustrated at the left is a standard Horton ellipsoidal - bottom tank of welded construction with cylindrical columns and an ellipsoidal roof. It holds 100,000 gals. and is 125 ft. to bottom.

CHICAGO BRIDGE & IRON COMPANY

CLEVELAND	CHICAGO	BIRMINGHAM	NEW YORK
HAVANA	DETROIT	ATLANTA	PHILADELPHIA
HOUSTON	TULSA	LOS ANGELES	SAN FRANCISCO

Plants at Chicago, Birmingham and Greenville, Pa.



One of the most important fire protection developments introduced in recent years is the use of water in fine spray form for the control and extinguishment of fire. "Automatic" FIRE-FOG is an outgrowth of this development and is, by virtue of its performance, a leader in the field.

Among the many exacting installations of "Automatic" FIRE-FOG is one standing guard over butadiene unloading operations at the Goodyear operated Rubber Reserve Plant at Akron, Ohio. Naturally, the complexity of operational facilities at this plant demand carefully studied fire hazard safeguards for every process . . . safeguards that will withstand rigorous test under the most difficult conditions 24 hours every day in the year.

The significant thing about an "Automatic" FIRE-FOG installation is its readiness for instant — automatic action now — next week — next year — in fact, whenever the danger of fire threatens.

You owe it to yourself, your personnel and your business to become fully informed on the merits of "Automatic" FIRE-FOG. Investigate today at no obligation. Write or call "Automatic" Sprinkler Corporation of America, Youngstown 1, Ohio.

"Automatic" Sprinkler devices and systems are listed by Underwriters' Laboratories, Inc., and approved by Factory Mutual Laboratories.

FIRE PROTECTION

DEVELOPMENT ENGINEERING

Automatic Sprinkler

MANUFACTURE INSTALLATION

"AUTOMATIC" SPRINKLER CORPORATION OF AMERICA
YOUNGSTOWN 1, OHIO
OFFICES IN PRINCIPAL CITIES OF NORTH and SOUTH AMERICA

VALVES
HYDRANTS
AND PIPE LINE ACCESSORIES

M & H furnishes a complete line of AWWA Valves, iron body, bronze mounted, with double-disc parallel seat or solid wedge type. Non-rising stem, outside screw and yoke, or with sliding stem and lever. Also furnished hydraulically operated. Square Bottom type operates in any position.

Post Indicator Valves, Indicator Posts, Check Valves, B & S Fittings

M & H Tapping Sleeve and Valve (illustrated above) is used to tap a main under pressure for the purpose of taking off a branch leading to automatic sprinklers, fire hydrants, etc. By this method the cut-in is made without interrupting the services on the existing water main.

AWWA & UNDERWRITERS APPROVED FIRE HYDRANTS

M & H Fire Hydrants are dry top and revolving head. They are easy to lubricate. Maintenance costs are low due to simplicity of design and rugged construction. They have low friction loss and great efficiency because barrel diameter is not reduced and there are no working parts or obstruction in waterway. Special Traffic model (shown at right) is designed to yield at the ground line under impact. Repair is simple and easy.

M&H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA

The New

DETEX GUARDSMAN

answers the question of long week-end and holiday closings

What to do about the Watchman during extended plant shutdowns is no longer a management worry.

The revolutionary new DETEX GUARDSMAN works on a continuous roll tape with a capacity of two full weeks' registration. It is the first tape clock to provide an embossed record made directly from type on the recording key. It employs no ribbons, carbons or inking devices.

Each of the 24 hours of every day has its own ruled space on the tape. The roll tape is synchronized with the clock mechanism . . . so that if your Watchman skips a round or neglects to register a single station the omission stands out like a locomotive headlight. Write for descriptive folder.

Approved by Underwriters Laboratories, Inc., Factory Mutuals Laboratory and insurance companies everywhere.

DETEX WATCHCLOCK CORPORATION

PATROL
ALERT
ECO
NEWMAN

76 VARICK STREET, NEW YORK 13, N.Y. Dept. N-4
Sales and Service in Principal Cities

THE FACTS ABOUT Von Duprin

TRADE MARK REG.

SELF-RELEASING FIRE AND PANIC EXIT DEVICES

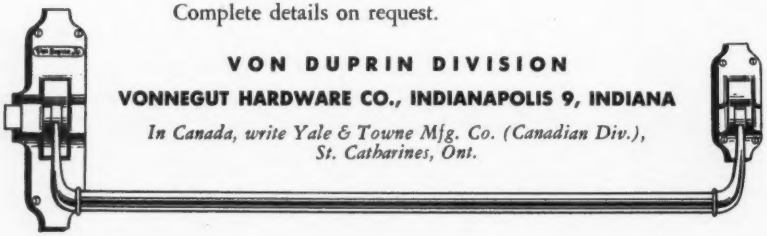
1. Von Duprin is the original . . . the first self-releasing exit device or "Panic Bolt," developed immediately after the disastrous Iroquois Theatre fire at Chicago.

2. Von Duprin has retained first place through constant improvement in mechanism and exterior design, culminating in the development of drop forged devices . . . outstandingly strong and shockproof.

3. The Von Duprin actuating mechanism is exceedingly simple in design, and greatly overstrength in every part. It stands up perfectly under the terrific demands of emergency operation.

4. The Von Duprin line is made up of so many types, with numerous special designs for unusual conditions, that the building owner can almost always get exactly what he needs, without makeshift adaptations to meet the conditions of the installation.

Complete details on request.



VON DUPRIN DIVISION

VONNEGUT HARDWARE CO., INDIANAPOLIS 9, INDIANA

In Canada, write Yale & Towne Mfg. Co. (Canadian Div.), St. Catharines, Ont.

STOP FIRES *before they start!*

PROTECTOSEAL*

PLUNGER CAN . . . provides safe — speedy way of dispensing flammable liquids . . . steps-up production and economizes solvents. A boon to all cleaning and swabbing operations. Available in 5 sizes . . . F.M. approved.

*PROTECTOSEAL — a method of safeguarding your plant against destruction — loss of life, property, and profits. Write for catalog covering many other devices safety-engineered to *stop fires before they start.*

THE PROTECTOSEAL CO., 1972 S. WESTERN AVE., CHICAGO 8, ILL.

"Eternal Vigilance"

—THE PRICE OF SECURITY!

WHETHER IT BE NATIONAL OR INDIVIDUAL PERFORMANCE . . . SECURITY IS ACHIEVED ONLY BY THE EVER-ALERT, EVER-CAPABLE AND EVER-DEPENDABLE!

All of these requisites for SECURITY against loss of life and property by fire are provided through the "ETERNAL VIGILANCE" of

STAR AUTOMATIC SPRINKLERS

Automatic Sprinklers
Corrosion-Proof Sprinklers
Directional Flow Sprinklers
Open Sprinklers
Spray Sprinklers
Alarm Devices

Automatic Releases
Standard Wet Pipe Systems
Dry Pipe Systems
Deluge Systems
Heat-Actuated Devices
Pre-Action Systems

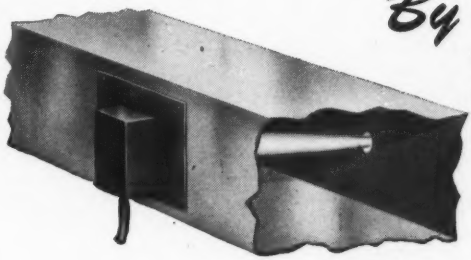
Star Automatic Sprinklers and Fire Protection Devices bear approval of all Insurance Authorities having jurisdiction and various Governmental Agencies

Economy in installation cost and maintenance has dictated the consistent policy of Star Sprinkler Corporation in distributing its Fire Protection Devices through local licensed contractors who have had a lifetime of experience in the installation of automatic sprinkler systems. Operating throughout the United States, Canada and South America, Star licensees, due to their strategic locations, can render instant service. Write us for name and address of Star licensed contractor nearest your location.

STAR SPRINKLER CORP.

Westmoreland and Collins Sts. — Philadelphia, Pa.

VENTILATING FIRE HAZARDS CONTROLLED



By ELECTRONIC SMOKE DETECTION IN VENTILATING DUCTS

THE Light Source projects a light-beam across the ventilating duct to the Receiver, which contains a sensitive photo-cell. When a predetermined density of smoke or industrial dusts intercept this light-beam, the ventilating fan stops automatically and warning is sounded. Permits the operation of ordinary thermal fire control equipment. It is simple to install — easy to maintain. The Worner Fan Motor Stop has been tested by years of application and meets the requirements of the National Board of Fire Underwriters. Write for details.

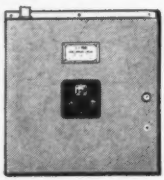
Price $245.00 f.o.b. Rankin

WORNER ELECTRONIC DEVICES

P. O. BOX 47, RANKIN, ILLINOIS

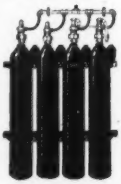
NOSE of a Bloodhound

SPEED of a Tiger



That's the New Underwriters' Approved Smoke Detector

A wisp of smoke from a faintly smoldering fire is all it takes to operate a C-O-Two Smoke Detector. The Detector sniffs air **continually** from all protected areas. If smoke is present, an alarm sounds and, like a tiger, a C-O-Two fire extinguishing system springs into action; the fire is smothered in seconds with a cloud of cold, dry, inert carbon dioxide gas. A few minutes later the area is ready for use again; no after-fire clean-up is necessary. Carbon dioxide won't harm finishes, fabrics or equipment. It is a non-conductor and can be used safely on live electric equipment. Snuffs out flammable liquid fires.



Investigate this new and modern method of detecting and extinguishing fire at its start. C-O-Two Smoke Detectors are not dependent on heat for operation. They are especially designed for fast detection of slow smoldering fires in record vaults and storage spaces.

C-O-TWO

C-O-TWO FIRE EQUIPMENT COMPANY

NEWARK 1 • NEW JERSEY

Sales and Service in the Principal Cities of United States and Canada

AFFILIATED WITH PYRENE MANUFACTURING COMPANY

3-WAY PROTECTION for patrons with fabrics that *CANNOT BURN*

Too many tragedies have resulted from flameproofed organic fabrics that could, and did, burn. For the efficiency of flameproofing depends entirely upon the type of chemical used, and the length of time since the last treatment. Moreover, lethal gases are generated when such fabrics are exposed to flame, causing additional deaths from asphyxiation.

MADISON THEATRE

in Covington, Ky.

Wall coverings of Fiberglas* fabric were chosen to assure maximum fire-safety. They dramatize the modern design of this new theatre —blue and rose ash Tropical Print, accented by Fiberglas* stage curtains of wide-striped lemon and silver. *Decorated by The F & Y Building Service, Columbus, Ohio.*

Fiberglas* fabrics, woven entirely of finely spun, *inorganic glass* filaments, are as naturally fireproof as your drinking glass. They afford 3-way protection in case of fire:

1—*Permanent non-combustibility.* Never require flameproofing; immune to rot or decay; always operate at 100% efficiency.

2—*Minimize the hazard of suffocation from oxygen depletion* in the event of fire in enclosed places.

3—*Will not emit asphyxiating smoke and fumes* if exposed to flame. Cannot burn, smolder or propagate flame.

WRITE FOR SAMPLES AND INFORMATION

THERMOTEL
FIREPROOF FABRICS

FIBERGLAS* Listed by Underwriters' Laboratories, Inc., as "Non-Combustible Fabric;" approved by the Bureau of Standards and Appeals, City of New York.

ARCHITECTS BUILDING, 101 PARK AVENUE, NEW YORK 17, N. Y. · LEXINGTON 2-0711

Sales representatives or recommended workrooms in: **BOSTON, BUFFALO, CHICAGO, CINCINNATI, CLEVELAND, DENVER, DETROIT, LOS ANGELES, NEW ORLEANS, OAKLAND, PHILADELPHIA, PITTSBURGH, ST. LOUIS, TOLEDO**

*T.M. Reg. U. S. Pat. Off. Owens-Corning Fiberglas Corp.

REGO
LP GAS EQUIPMENT

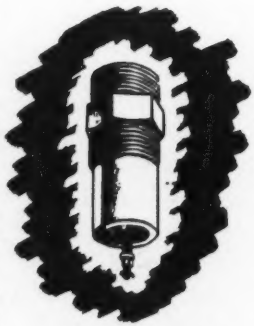
Specified For...

PERFORMANCE PLUS SAFETY!

Here's Why:

- It is listed by Underwriters' Laboratories
- It conforms to N.F.P.A. Standards
- It is manufactured only after thorough field testing
- It is shipped only after being rigidly inspected and tested at the factory

Typical of the many RegO-designed devices for insuring the safe use of LP Gases are RegO Excess Flow Check Valves. These valves, which shut off the flow of fuel should a break in the line occur, may be used with butane or propane in either a gaseous or liquid state. They function with complete efficiency whether mounted vertically or horizontally. A complete range of sizes provides valves suitable for every use, from small domestic installations to large bulk plant or industrial applications.



RegO Excess Flow Check Valves

REGO LP GAS EQUIPMENT

The BASTIAN-BLESSING Company

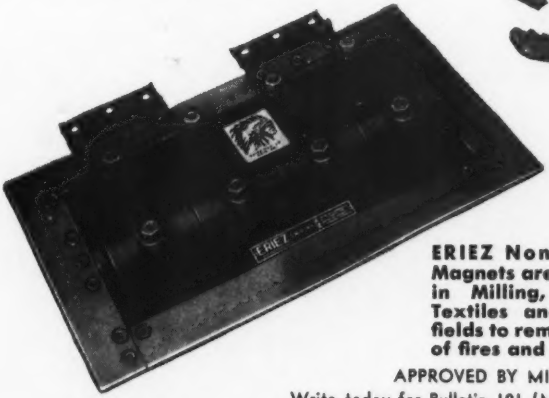
4201 West Peterson Avenue Chicago 30, Illinois

PIONEER AND LEADER IN THE DESIGN AND MANUFACTURE OF PRECISION EQUIPMENT FOR USING AND CONTROLLING LP GASES

TRAMP IRON

A DANGEROUS TRAVELER UNLESS YOUR PROTECTION IS *Eriez* MAGNETS . . .

1. **Comply with NFPA Dust Explosion Codes.**
2. **Entirely *Non-Electric* — cannot Spark.**
3. **Magnetic Field Guaranteed to Last.**
4. **Lowest Initial Cost.**
5. **No Operating Cost. No Repair Cost.**
6. **Lightest and Most Compact.**
7. **Easiest to Install.**
8. **Made Any Size to Fit Your Requirements.**
9. **MOST PROTECTION PER DOLLAR.**



PATENT PENDING

ERIEZ Non-Electric Permanent Magnets are preferred equipment in Milling, Chemicals, Plastics, Textiles and General Industrial fields to remove tramp iron, cause of fires and explosions.

APPROVED BY MILL MUTUALS

Write today for Bulletin 101 (Milling), 102A (Industrial), 104 (Textiles), 105 (Magnetic Sweeper), 106 (Plastics).

When It's Magnetic Protection . . . See Eriez First

ERIEZ MANUFACTURING COMPANY

39 East 12th Street · Erie Pennsylvania

THE MASTER OF FLAME
ANSUL
FIRE EXTINGUISHING EQUIPMENT
duGas

DRY CHEMICAL FIRE EXTINGUISHERS

WRITE TODAY FOR CHARTS SHOWING COMPARATIVE RATINGS ON FLAMMABLE LIQUID FIRES AS DETERMINED BY NATIONALLY RECOGNIZED APPROVAL AGENCY.

Highest Ratings for Speed and Effectiveness

WITH THE NEW ANSUL-DUGAS DRY CHEMICAL FIRE EXTINGUISHER

Speedy-fast action is the first essential in preventing major fire damage. The NEW Ansul-Dugas Extinguishers, for Class B and C fires have the highest ratings for SPEED and EFFECTIVENESS, pound for pound, as determined by impartial authority. These highest ratings mean positive put-out of your incipient fires by ANY of your employees.

STOP FIRE FASTER!

with Ansul-Dugas Dry Chemical Extinguisher

FEATURES OF THE NEW ANSUL-DUGAS EXTINGUISHER

- Greatly increased fire-killing power.
- Expert extinguishing by inexperienced operators.
- Simplified—faster operation.
- Quicker, easier, on-the-spot recharge after use.
- Greater fire-fighting effectiveness, pound for pound, dollar for dollar.
- Longer range stream and greater shielding of heat from operator.
- Increased fire-fighting capacity without increased weight.
- Engineered to resist corrosion.

ANSUL CHEMICAL COMPANY
FIRE EXTINGUISHER DIVISION, MARINETTE, WISCONSIN

Eliminate

Delayed Alarms

Reduce

Fire Losses

WHEN FIRE OCCURS

Call the Fire Department. Delay creates unnecessary fire waste and life hazard

Fire Alarm Boxes
Save Time and Protect Life, Property and Income

Write for details

THE GAMEWELL COMPANY

Newton Upper Falls 64 - - Massachusetts

2

PROPERTY GROUPS

There are always two groups of industrial, commercial, and institutional properties.

One group is destroyed by fire annually — last year the loss was nearly $500,000,000.

The other group, valued at over 70 billion dollars, is protected against fire by Grinnell Systems. Its annual fire loss is trifling.

There is a type of Grinnell System for every fire hazard. Each is backed by over 75 years of experience. Complete information is available for the asking from any of our offices throughout the country. Grinnell Company, Inc., Providence 1, Rhode Island.

GRINNELL SYSTEMS

Protection Against Fire